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DO PSYCHOSOCIAL WORKING CONDITIONS CONTRIBUTE TO HEALTHY AND ACTIVE AGING? STUDIES OF MORTALITY, LATE-LIFE HEALTH, AND LEISURE

Charlotta Nilsen



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Do psychosocial working conditions contribute to healthy and active aging? Studies of mortality, late-life health, and leisure

THESIS FOR DOCTORAL DEGREE (Ph.D.)

By

Charlotta Nilsen

Principal Supervisor:

Professor Ingemar Kåreholt
Karolinska Institutet
Department of Neurobiology,
Care Sciences and Society
Aging Research Center

Opponent:

Professor emerita Eva Vingård
Uppsala University
Department of Medical Sciences
Occupational and Environmental Medicine

Co-supervisors:

Professor Ross Andel
University of South Florida
College of Behavioral and Community
Sciences
School of Aging Studies

Examination Board:

Professor emeritus Töres Theorell
Karolinska Institutet
Department of Neuroscience

Associate Professor Neda Agahi
Karolinska Institutet
Department of Neurobiology,
Care Sciences and Society
Aging Research Center

Professor Mikael Rennemark
Linnaeus University
Department of Psychology

Associate Professor Linda Magnusson Hanson
Stockholm University
Stress Research Institute

Professor Johan Fritzell
Karolinska Institutet
Department of Neurobiology,
Care Sciences and Society
Aging Research Center

*Friday the 19th of January 2018 at 1 pm
CMB-salen, Berzelius väg 21, Karolinska Institutet, Solna*

To my parents, Caisa Westberg Nilsen and Jan Nilsen

Till minne av min mormor Marianne
1915-05-31 – 2017-12-01

Abhyāsa

To never give up, keep focus, keep focus with patience, commitment

ABSTRACT

The growing demographic challenge posed by an aging population makes finding predictors of health in old age increasingly important. This thesis investigated long-term associations between midlife psychosocial working conditions and late-life health and leisure and examined whether sense of coherence in midlife modified the association between psychosocial working conditions and all-cause mortality. The studies were based on individually linked data from the Swedish Cause of Death Register and two Swedish longitudinal surveys, the Level of Living Survey (LNU) and the Swedish Panel Study of Living Conditions of the Oldest Old (SWEOLD).

The results of Study I and Study II suggest that self-reported adverse psychosocial working conditions in late midlife, especially low job control, high strain, or passive jobs, were associated with complex health problems and limitations in physical functioning 20-24 years later. However, women and men seemed to be vulnerable to different self-reported psychosocial working conditions. High job strain (high psychological demands and low control) was more negative for women than men. Passive jobs (low psychological demands and low control) were negative for men but not for women.

The results of Study III suggest that a weak sense of coherence magnified the association between occupation-based (measured with a job exposure matrix) high job strain in midlife and mortality in women and men and self-reported passive jobs in midlife and mortality in men.

The results of Study IV suggest that occupation-based active jobs (high psychological demands and high control) in midlife were associated with physical, social, and intellectual/cultural activity 23 years later in women and men.

In summary, the results underscore the importance of psychosocial working conditions in midlife for health, physical functioning, and leisure activity after retirement—and thus for healthy and active aging. It is therefore important to reduce stress at work but at the same time induce intellectual stimulation and personal growth. Moreover, it is important to find ways to strengthen sense of coherence in midlife to buffer the negative influence of adverse psychosocial working conditions on health. Investing in healthy workplaces and strengthening sense of coherence to improve the health of workers may reduce societal costs during working age. It may also lower the cost of health and social care by improving the health of the older population. Hence, it would be a double-win investment for society.

Keywords: psychosocial working conditions, work stressors, active jobs, passive jobs, sense of coherence, middle age, socioeconomic position, mortality, physical functioning, lung function, leisure activity, old age, Sweden, longitudinal

SAMMANFATTNING

Vi lever allt längre. Detta ses ofta som något positivt och ett långt liv har varit människans strävan sedan urminnes tider. Det som eftersträvas är dock ett långt liv vid god hälsa och inte en förlängd period i beroende av vård och omsorg. När vi blir äldre ökar sannolikheten för hälsoproblem och både fysisk och kognitiv funktionsförmåga försämras. Detta kan resultera i ett minskat välmående hos individen, men även ökade vård- och omsorgskostnader då andelen äldre personer ökar. Det är därmed av stor vikt att finna faktorer som kan bidra till god hälsa och funktionsförmåga i hög ålder.

Att arbeta innebär för de flesta ekonomisk trygghet, men även status, identitet och en känsla av meningsfullhet. Arbetet kan dock även vara en källa till stress. Det finns ett starkt empiriskt stöd för att arbetsrelaterad stress påverkar vår hälsa negativt. Det finns också ett växande empiriskt stöd för samband mellan arbetsrelaterad stress och kognitiv funktionsförmåga och demenssjukdom i hög ålder. Vi vet dock mindre om möjliga samband mellan arbetsrelaterad stress och andra vanliga hälso- och funktionsnedsättningar i hög ålder, till exempel nedsatt fysisk funktionsförmåga och komplexa hälsoproblem (att ha svåra problem i lika hälsoområden). Vi vet sedan tidigare att fördelar och nackdelar tenderar att ackumuleras över tid. Långvarig stress kan komma att påverka vår livsstil, till exempel fysisk inaktivitet, vilket i sin tur ökar risken för ohälsa på sikt. Långvarig stress kan även direkt påverka vår kropp negativt, vilket kan leda till ökad risk för ohälsa senare i livet.

I den här avhandlingen mäts psykosociala arbetsförhållanden med krav-kontrollmodellen. Stressiga arbetsförhållanden, ”spända” arbetssituationer, definieras av höga psykiska krav kombinerat med litet beslutsutrymme i form av påverkansmöjlighet och kunskapskontroll/stimulans (kontroll) i arbetet. Aktiva jobb, där höga psykologiska krav kombineras med hög kontroll, kan bidra med intellektuell stimulans och personlig utveckling så länge beslutsutrymmet möjliggör att psykiska krav ses som stimulerande utmaningar och möjlighet till personlig utveckling istället för stress. På sikt leder detta till en ökad förmåga att hantera stressiga situationer. Aktiva jobb har kommit att kallas just aktiva då man funnit ett samband mellan aktiva jobb och en aktiv fritid. Passiva jobb innebär det motsatta. Här kombineras låga psykiska krav med lågt beslutsutrymme. Detta kan leda till en passivitet både på jobbet och på fritiden.

Det övergripande syftet med denna avhandling var att undersöka långsiktiga samband mellan psykosociala arbetsförhållanden i medelåldern och komplexa hälsoproblem, fysisk funktionsförmåga och fysiska, sociala och intellektuella/kulturella fritidsaktiviteter i hög ålder, med 20 till 24 års uppföljningstid. Syftet var även att undersöka om känsla av sammanhang (KASAM), att uppleva livet som meningsfullt, hanterbart och begripligt, påverkade sambandet mellan psykosociala arbetsförhållanden och dödlighet. Riksrepresentativa data från Levnadsnivåundersökningen (LNU), SWEOLD-studierna och dödsorsaksregistret användes i analyserna.

I den första delstudien undersöktes sambandet mellan spända jobb i slutet av arbetslivet (medianålder 57) och komplexa hälsoproblem i hög ålder (medianålder 80) och mellan passiva jobb i slutet av arbetslivet och komplexa hälsoproblem i hög ålder. Resultaten visade

att det fanns ett samband mellan spända jobb och komplexa hälsoproblem i hög ålder, men att utbildningsnivå kunde förklara detta samband. Dock kvarstod ett samband mellan passiva jobb och komplexa hälsoproblem i hög ålder bland män. I den andra delstudien undersöktes sambandet mellan spända jobb i slutet av arbetslivet (medianålder 60) och fysisk funktionsförmåga i hög ålder (medianålder 80) och mellan passiva jobb i slutet av arbetslivet och fysisk funktionsförmåga i hög ålder. Fysisk funktionsförmåga mättes med självrapporterad mobilitet samt test av lungfunktion och tester av styrka, rörlighet och handfunktion. Resultaten visade ett samband mellan spända jobb och nedsatt mobilitet bland kvinnor i hög ålder. Resultaten visade även ett samband mellan passiva jobb och nedsatt lungfunktion och nedsatt styrka, rörlighet och handfunktion bland män i hög ålder.

I den tredje delstudien undersöktes om en stark känsla av sammanhang kunde påverka sambandet mellan psykosociala arbetsförhållanden (passiva, aktiva och spända jobb) i medelåldern (medianålder 50) och dödlighet. Resultaten visade att en svag känsla av sammanhang förstärkte sambandet mellan spända jobb och dödlighet bland kvinnor och män och mellan passiva jobb och dödlighet bland män. Detta antyder att en stark känsla av sammanhang kan underlätta för människor med hög arbetsrelaterad stress.

I den fjärde delstudien undersöktes sambandet mellan aktiva jobb i medelåldern (medianålder 53) och fysiska, sociala, och intellektuella/kulturella fritidsaktiviteter i hög ålder (medianålder 76). Resultaten visade att det fanns ett samband mellan aktiva jobb och fysisk aktivitet i medelåldern bland kvinnor och män. Resultaten visade även att det fanns ett samband mellan aktiva jobb och en aktiv fritid i hög ålder bland kvinnor och män, i form av sociala, fysiska och intellektuella/kulturella fritidsaktiviteter. Detta samband bestod även när hänsyn togs till fritidsaktiviteter i medelåldern, vilket antyder att aktiva jobb ”byttes ut” mot en aktiv fritid efter pensionering.

Sammanfattningsvis visar avhandlingens resultat vikten av psykosociala arbetsförhållanden i medelåldern för hälsa, fysisk funktionsförmåga och en aktiv fritid bland äldre personer. Allt detta är komponenter som ingår i ett hälsosamt och aktivt åldrande. Det är därför viktigt att minska den arbetsrelaterade stressen, men även bidra till intellektuell stimulans och personlig utveckling på arbetet. Investeringar i hälsosamma arbetsplatser, samt en förstärkning av KASAM, kan förbättra hälsan i arbetsför ålder och därmed minska samhällskostnader som konsekvens av ohälsa. Det kan också minska vård- och omsorgskostnader för äldre personer genom att förbättra hälsa och funktionsförmåga senare i livet. Därmed skulle det vara en ”double-win”- investering för samhället.

Nyckelord: psykosociala arbetsförhållanden, arbetsrelaterad stress, aktiva jobb, känsla av sammanhang (KASAM), medelåldern, socioekonomisk position, dödlighet, fysisk funktion, lungfunktion, fritidsaktiviteter, hög ålder, Sverige, longitudinell.

LIST OF SCIENTIFIC PAPERS

This doctoral thesis is based on the following original papers, referred to in the text by their Roman numerals:

- I. Nilsen, C., Andel, R., Fors, S., Meinow, B., Mattsson, A. D., & Kåreholt, I. (2014). Associations between work-related stress in late midlife, educational attainment, and serious health problems in old age: a longitudinal study with over 20 years of follow-up. *BMC Public Health*, 14(1), 878.
- II. Nilsen, C., Agahi, N., & Kåreholt, I. (2017). Work stressors in late midlife and physical functioning in old age. *Journal of Aging and Health*, 29(5), 893-911.
- III. Nilsen, C., Andel, R., Fritzell, J., & Kåreholt, I. (2016). Work-related stress in midlife and all-cause mortality: can sense of coherence modify this association? *The European Journal of Public Health*, 26(6), 1055-1061.
- IV. Nilsen, C., Andel, R., Fritzell, J., Agahi, N., & Kåreholt, I. (submitted for publication). The influence of active jobs in midlife on leisure activity in old age.

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Paper III is a pre-copyedited, author-produced PDF of an article accepted for publication in The European Journal of Public Health following peer review. The version of record [Nilsen, Charlotta, et al. "Work-related stress in midlife and all-cause mortality: can sense of coherence modify this association?" The European Journal of Public Health 26.6 (2016): 1055-1061] is available online at: <https://doi.org/10.1093/eurpub/ckw086>

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Sindi, S., Hagman, G., Håkansson, K., Kulmala, J., Nilsen, C., Kåreholt, I., Soininen, H., Solomon, A., Kivipelto M. (2016). Midlife work-related stress increases dementia risk in later life: The CAIDE 30-Year Study. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, doi:10.1093/geronb/gbw043.

Parker, V., Andel, R., Nilsen, C., & Kåreholt, I. (2013). The association between mid-life socioeconomic position and health after retirement—exploring the role of working conditions. *Journal of Aging and Health*, 25(5), 863-881.

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1 INTRODUCTION

Life expectancies are rising; more and more people are surviving to older ages. Combined with lower birth rates, this change means that both the number and the proportion of older people in the population are rising. Today, about 20 percent of the population in Sweden is older than 64 years, and about 3 percent is older than 85. In the next 50 years, these numbers are expected to reach 25 percent and 6 percent, respectively (SCB, 2017). Extending human life expectancy has been the target of scientific pursuit since ancient time, so the shift is a story of success made possible by advances in medical technology and living conditions. However, there are costs that come with our recent success in the pursuit of longer lives. As we age, health problems and functional and cognitive limitations increase (Beydoun et al., 2014; Fillenbaum et al., 2000; Welmer et al., 2012). The high prevalence of comorbidity and complex health problems among the oldest old (Heap, 2016; Marengoni et al., 2011; Meinow et al., 2006) result in greater demands on health and social care services as the proportion of people in older ages increases (Jagger et al., 2011; Parker & Thorslund, 2007).

Because of the growing challenge posed by an aging population, finding predictors of healthy and active aging is increasingly important. Late-life health and survival reflect the accumulation of a multitude of personal and environmental influences over the life course. Work occupies much of our adult lives, which makes it likely that the workplace is important for health and aging. Research into the effects of work on health indicates that work stress is associated with ill health when people are of working age (e.g., SBU, 2012; 2013; 2014a; 2014b; 2015) as well as after they leave the workforce (Siegrist & Wahrendorf, 2011), and some effects are only apparent years after retirement. To better comprehend how work stress is associated with health and function far beyond working life, longitudinal studies that span more than a few years are needed. There is growing evidence of such long-term associations between work stress and cognitive impairment, dementia, and poor mental health in old age (e.g., Andel et al., 2012; Parker et al., 2013; Sindi et al., 2016; Then et al., 2013; Wahrendorf et al., 2012; Wahrendorf et al., 2013). However, studies investigating long-term associations between psychosocial working conditions and other health and functional outcomes in old age are sparse (Kulmala et al., 2013, 2014; Wahrendorf et al., 2012). Work-related resources may also accumulate over the life course and act as factors that protect health (Hakanen, Bakker, & Jokisaari, 2011). With the gradual increase in retirement age that has been proposed as part of the solution to meeting the demands of an aging population, the importance of work on future health will most probably grow stronger.

The overall aim of this doctoral thesis is to investigate long-term associations between psychosocial working conditions and health and leisure activity later in life.

2 THEORIES AND CONCEPTS

This chapter provides definitions of the concepts and theories used throughout this thesis. It begins with definitions of the terms “stressors” and “stress”. Next, a brief overview of the most central concept in the thesis, the job demand-control model, is found. The concept of sense of coherence is then presented as a possible modifier of stress. Finally, a life course approach to healthy and active aging explains the conceptual framework for this thesis, including the life course perspective and the continuity theory of aging.

2.1 STRESSORS AND STRESS

Stress is not a new phenomenon. The term stress can be traced back to the early thirties (1930s) and the discovery of the alarm reaction. During the next few decades, different definitions of stress emerged. To a varying extent, they all acknowledged that stress is an individual experience triggered by demands or pressure that exceeds a person’s ability to cope with the situation. However, the terms “stressors” and “stress” are sometimes used interchangeably, but they do not mean the same thing. Stressors are found in the environment; they are stimuli that cause a stress response.

2.1.1 The stress response

The stress response can be influenced by age, gender, genetics, personality, prenatal and postnatal experiences, and major life events (Anisman, 2014). It is the activation of the “fight and flight” response, an anti-inflammatory response that starts when the person’s perceived resources are not sufficient to meet perceived demands. The trigger can be a threat, a challenge, or harm/loss (Brunner & Marmot, 2005). Two main systems are active in the stress response: the sympatho-adrenal-medullary (SAM) system, also called the SAM activation, and the hypothalamic-pituitary-adrenal (HPA) axis (i.e., hypothalamus, pituitary gland, and adrenal gland). SAM activation occurs when a person experiences a threat to their survival. It is the body’s first reaction to a stressor and adrenaline is the main hormone. After SAM activation, the HPA axis begins an adjustment phase, in which the immune, endocrine, musculoskeletal, cardiovascular, and nervous systems work together to magnify the body’s response to stress (the fight-or-flight response). Corticosteroids, including cortisol, are the main family of response-stimulating hormones in the HPA axis. Unlike the SAM system, which uses the sympathetic nervous system as its carrier, the HPA axis uses hormones as carriers. It is therefore slower but also more persistent over time, and hence plays a major role in ultimately bringing about adverse changes in health due to prolonged exposure to stress (Brunner & Marmot, 2005; Anisman, 2014).

A stressor, or stress, does not necessarily damage the body. It may even be healthy in small amounts. It is when stress is sustained without periods of recovery that it becomes a threat to health. Allostasis, the body’s inherent ability to maintain internal balance (homeostasis), occurs when the body adapts to external demands (stressors). When these adaptive systems are working, the body is able to turn the systems on and off efficiently and handle challenges. The level to which these allostatic systems are stimulated or strained is called “allostatic

load”, which disrupts homeostasis and leads to dysregulation of different systems in the body (McEwen & Stellar, 1993). Allostatic load (“wear and tear” on the body) appears when a person is exposed to chronic stress (Karlman et al., 2002).

2.2 MODELS OF WORK-RELATED STRESS

Next to health and family, people consider work one of the most important things in life. We work to provide financial security, but also for status, identity, and a sense of purpose (Lundberg & Cooper, 2010; Waddell & Burton, 2006). When we work, we function in a work environment. The work environment consists of physical and psychosocial factors, which are intertwined. Physical work factors include things such as the room we are in, noise, light, and equipment. The term “psychosocial factors” refers to the interaction between psychological and social factors (Theorell, 2012). That is, how individuals experience and respond to their surroundings (e.g., their emotions, cognition, and behaviors).

There are two origins of stress-related illness: the person and the environment. The role played by each is, however, still a matter of ongoing discussion. Researchers have made several attempts to define work stressors in the psychosocial work environment. Examples include time pressure, overload, too much or too little responsibility, working alone, and conflict in roles. Hence, there are many different work-related stress models; e.g., the effort-reward imbalance model (ERI), the job demands-resources model, and the demand-skill-support model (Mark & Smith, 2008). One of the most frequently used is the job demand-control model (also called the job strain model) (Karasek, 1979; Karasek & Theorell, 1990).

2.2.1 The job demand-control model

The job demand-control model (Figure 1), introduced by Karasek (1979), is environmentally based. That is, it is based on how work is organized and how the way it is organized—its structure—is related to health. This model focuses on stressors in psychosocial work environment. The demand dimension is measured with psychological demands (Karasek, 1979). The control dimension covers two sub-dimensions: personal schedule freedom (decision authority) and intellectual utilization (skill discretion). Decision authority and skill discretion are closely related and often used as one dimension to measure job control (Karasek & Theorell, 1990). Two hypotheses have been derived from the job demand-control model: the strain hypothesis and the active learning hypothesis.

In the strain hypothesis, to have high job strain (high psychological demands combined with low decision latitude/control) is considered to reflect a stressful work environment (Karasek, 1979; Sun et al., 2007). On the other side of the spectrum is low job strain (low demands combined with high control), which is theoretically the ideal scenario (Theorell, 2000). The job demand-control model was later expanded to include social support at work (Johnson & Hall, 1988; Johnson, Hall, & Theorell, 1989), resulting in the job demand-control-support (JDACS) model. Low social support may exacerbate the negative impacts of high job strain, and was added in the model and referred to as iso-strain. The (iso)strain hypothesis states that the highest level of illness is anticipated when a person works in an environment of high job demands, low job control, and low social support (Johnson et al., 1989).

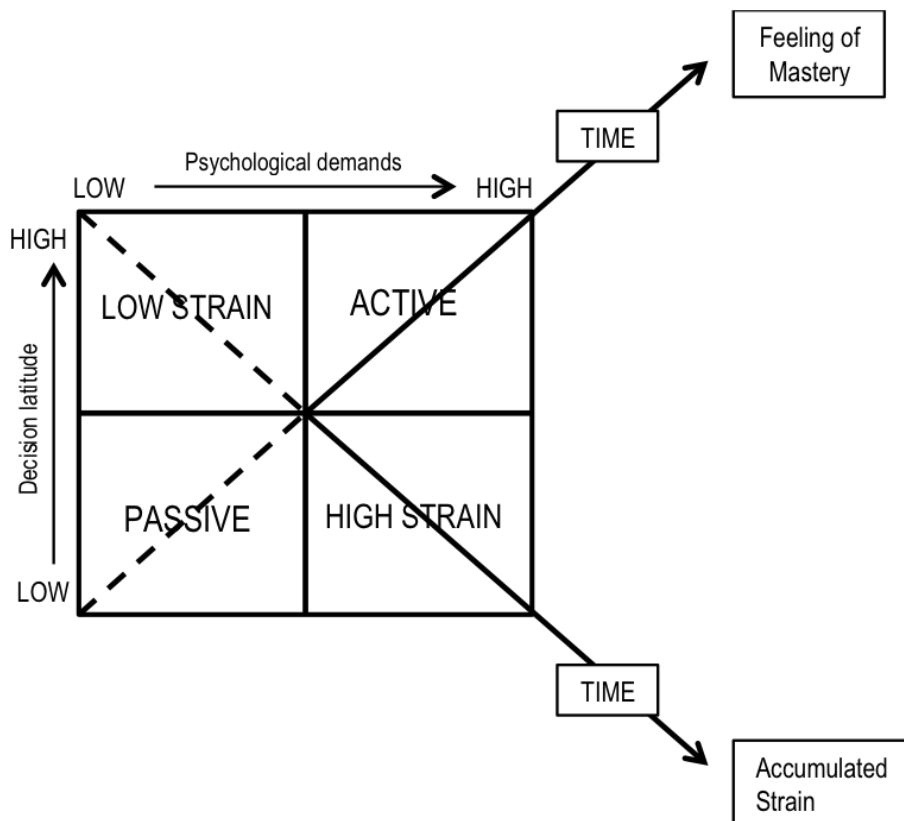


Figure 1. The job demand-control model. Source: Karasek & Theorell (1990), modified by author.

The active learning hypothesis, the active dimension of the job demand-control model (high demands combined with high control), has been studied less than the strain hypothesis. Active jobs are challenging, stimulating, and motivating jobs without the negative impact of psychological strain. The active learning hypothesis suggests that taxing situations in life can be challenges and opportunities for personal growth and increased learning (i.e., learning new behavior patterns) that with time increase feelings of mastery and skills. This effective problem solving can make a person learn to take action when faced with challenges rather than being stymied by them (Karasek & Theorell, 1990). Thus, learning may reduce the perception of situations as stressful, but only when the person's capabilities are equal to the demands and when a situation is challenging enough to be interesting (Theorell & Karasek, 1996). On the other side of this spectrum is the passive dimension of the job demand-control model (low demands combined with low control). A passive job situation can induce a loss of skill and unlearning, and people in passive jobs can perceive even moderate demands as stressful (Karasek & Theorell, 1990). Understimulation is related to stress responses and symptoms similar to those that result from overstimulation (Frankenhaeuser et al., 1971; Frankenhaeuser & Ödman, 1983). There are, however, many factors that may modify the negative health consequences of stress exposure. Having the resources needed to handle a stressful situation is what the concept of sense of coherence is about.

2.3 THE CONCEPT OF SENSE OF COHERENCE

Aaron Antonovsky (1987) introduced the concept of sense of coherence over 30 years ago that measure a person's view of life, identity, and use of resources in stressful situations to influence health and quality of life. It is a salutogenic perspective; i.e., it focuses on health rather than disease (salutogenesis). Antonovsky did not agree with the traditional medical model, which separated health and disease. Instead, he saw health as a continuum. Antonovsky wanted to understand why some people become ill under stress and others stay healthy. The concept originates from interviews of Israeli women who survived the concentration camps of the Second World War and stayed healthy in spite of this (Antonovsky, 2005).

According to the concept, a person's response to life stress has three components: meaningfulness, manageability, and comprehensibility (Antonovsky, 1987). Meaningfulness is the extent to which a person thinks life makes sense and challenges are worth facing. It helps people feel motivated to cope with stressors and is thus the motivating component of sense of coherence. Manageability is the extent to which people feel they have the resources to cope with stressors, either on their own or through their friends and families. It is the behavioral component of sense of coherence. Comprehensibility is the extent to which a person thinks the challenges they face seem logical and structured, and not chaotic, random, or unexpected. It is the cognitive component of sense of coherence (Antonovsky, 2005). Hence, sense of coherence is not a coping strategy, but an indicator of the overall way people organize and orient themselves. A strong sense of coherence increases the capacity to find the coping strategies that are needed when facing challenging life events across the life course (Antonovsky, 1987).

2.4 A LIFE COURSE APPROACH TO HEALTHY AND ACTIVE AGING

Aging is not something that occurs suddenly, but is a process that goes on during most if not all of life. The aging process occurs in all individuals and is associated with an increase in our chronological age, as well as with the less easily measurable biological changes. These changes are gradual (or insidious), mostly irrevocable, affect all of our bodily functions and, ultimately, our chance of survival. But aging is so much more than the body's biological deterioration or a biological clock that is ticking.

2.4.1 The life course perspective

The life course perspective is a holistic approach that enables researchers to take a broad perspective on what affects health in old age. Using this perspective, we can study long-term biological, behavioral, and psychosocial processes during different periods of life and even across generations (Kuh et al., 2014). The life course perspective enable us to examine how chronological age interacts with our relationships, various events/transitions in life, and social changes that shape us from birth to death (Hutchison, 2010). Scientists from different disciplines have promoted a lifespan or life course approach to understanding the aging process, and the approach has been discussed as a common conceptual framework for the interdisciplinary field of aging research (Kuh et al., 2014).

Although age and aging are important factors in the life course perspective, period and cohort effects are also relevant. Historical context, including societal changes, can influence a whole population in a similar way during a specific time period. This influence is known as a *period effect*. Societal changes can also influence different birth cohorts differently; this is known as a *cohort effect*. However, all individuals in a historical period and in a cohort are not identical; hence, people will be affected differently by historical context, and there will be differences within birth cohorts, as well (Kuh et al., 2003).

Different life course models have been defined: (1) critical or sensitive period model; (2) accumulation of risk model; and (3) chain of risk model. The critical or sensitive period model focuses on an exposure earlier in life that has long-term effects on the outcome that are not modified by experience later in life. In a variation of this model, the exposure during the sensitive period may also interact with exposures later in life, which may change the effect on the outcome. The accumulation of risk model focuses on the amount of negative events throughout the life course; whereas the timing of negative events is not at focus. The model posits that as the duration, number, and severity of exposure increase, cumulative damage to the biological system occurs, for example as a result of chronic stress. Allostatic load has been shown to increase with age, which indicates that allostatic load may be a measure of cumulative burden to the physical body (Sun et al., 2007). Moreover, chronic stress have been suggested to hasten biological aging (Salmon, Richardson, & Pérez, 2010). The accumulated exposures may be clustered or independent of each other. The chain of risk model is a version of the accumulation model that asserts that sequences of linked exposures lead to ill health. Chain of risk enhance disease risk because one bad experience tends to lead to another. For example, if stressed, you may be less likely to be physically active and more likely to smoke, which in turn affects health. Another example is that work stress may increase the risk of sick leave, which may lead to a loss of income. Income, in turn, is related to access to health services and certain leisure activities, which may affect health (Galobardes et al., 2006; Kuh et al., 2003; Thoits, 2010). Both hypotheses suggest an accumulation of disadvantages or advantages over the life course (Kuh et al., 2014).

2.4.2 The continuity theory of aging

The continuity theory of aging is a theory of adaptation. Robert Atchley (1989) formulated the continuity theory in 1989. However, as early as 1968, George Maddox had used the idea of continuity when he observed a consistency in the way people engaged in activities as they aged. According to the continuity theory, a person's experiences at an early age can influence behaviors at a later age, thereby creating continuity throughout the life course (Diggs, 2008). This continuity is both internal (psychological) and external (related to structures in the social and physical environment; e.g., behaviors, lifestyles, activities, and relationships). For example, active leisure earlier in life has been associated with active leisure later in life (Agahi, Ahacic, & Parker, 2006). The way people use leisure time develops, grows, changes, and adapts in a way consistent with their past experiences and underlying ideology (Diggs, 2008). According to the continuity theory of aging (Atchley, 1989), middle-aged and older adults strive to maintain structures created in the past to maintain a sense of continuity between past and present, and they do so by making adaptive choices. Hence, continuity does

not require structures identical to those from the past, but rather a persistence of general patterns.

2.4.3 Healthy and active aging

The concepts “healthy aging,” “active aging,” and “successful aging” are increasingly common in research and policy documents. Although the constructs are broadly similar, a variety of measures are used to define them (Kuh et al., 2014). A review article that covered 28 studies between 1978 and 2005 found 29 definitions of healthy or successful aging (Depp & Jeste, 2006).

The Public Health Agency of Sweden (2017) defines “healthy aging” as “a process where the opportunities of physical, social and mental health are optimized, so that the elderly can participate actively in society and enjoy an independent life with good quality of life without being discriminated against due to age.” The concept of “active aging” was developed as a policy response to challenges posed by an aging population (Foster & Walker, 2014) and sprang from the United Nations’ principles of participation, dignity, independence, care, and self-fulfillment. “Active” refers to continued participation in society; in the workforce; and in physical, cultural, economic, social, and political activities (WHO, 2017). Independence and continued participation in society are key goals of active aging policies, which emphasize older people as a resource to their communities and families. Rowe and Kahn’s (1997) classification of “successful aging”, which is perhaps the most frequently referenced, consists of three components: (1) low probability of disease, (2) high cognitive and physical functional capacity, and (3) active engagement with life. Although it is common for researchers to include all three components in their definitions of healthy or successful aging, some prefer to exclude active engagement (Kuh et al., 2014).

Expectations for active and healthy aging are often framed by researchers and policy makers, who tend to apply a youthful perspective. That is, viewing old age as an extension of youth rather than a natural process (Reed, Cook, Childs, & Hall, 2003). Although active aging challenge stereotypes of dependency and passivity in older age by emphasizing participation and autonomy, it may still foster an unrealistic ideal of aging (Foster & Walker, 2014).

3 PSYCHOSOCIAL WORKING CONDITIONS AND HEALTH

Health is a multidimensional concept. As stated by WHO¹, “*Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.*” Earlier research has established a strong link between work stress and physical and mental ill health, including sleep disturbance, musculoskeletal pain (pain in the back, shoulder, and neck), coronary heart diseases/symptoms, poor general psychological well-being, depression, anxiety, fatigue, chronic fatigue syndrome, emotional exhaustion, and diabetes (Häusser, Mojzisch, & Schulz-Hardt, 2011; Magnusson Hanson et al., 2008; Mutambudzi & Javed, 2016; Nixon et al., 2011; Nyberg et al., 2013; SBU, 2012; 2013; 2014a; 2014b; 2015; Stansfeld & Candy, 2006; Theorell et al., 2016). As a consequence, work stress is also a predictor of sick leave (Vingård, 2015) and disability retirement (Canivet et al., 2013; Clausen, Burr, & Borg, 2014). Active jobs have been associated with e.g., psychological well-being and personal growth (Karasek & Theorell, 1990; Olsson, Hemström, & Fritzell, 2009). Passive jobs have been associated with e.g., psychological atrophy, increased risk of diabetes, coronary heart disease, and higher risk of mortality (Amick et al., 2002; Karasek & Theorell, 1990; Mutambudzi & Javed, 2016). The psychosocial working conditions that increase the risk of ill health are, however, unequally distributed between social groups, i.e., there is a selection into jobs with adverse psychosocial working conditions.

3.1 SOCIAL INEQUALITIES IN HEALTH IN RELATION TO WORK

Societies are stratified, which means that resources in society are unevenly distributed. Unequal distribution of resources results in political, financial, cultural, and social advantages that later lead to health differences. A person’s position in the social structure usually refers to their position in society’s socioeconomic structure; i.e., in the hierarchy of educational levels, in the occupational system, and in the distribution of income (Galobardes, Lynch, & Davey Smith, 2007). There is a health gradient associated with social stratification such that the higher a person’s social position, the better the person’s health (Crimmins & Cambois, 2003; Mackenbach et al., 2008; Thoits, 2010). Advantages and disadvantages have a tendency to accumulate throughout the life course (Blane, 2011), which may cause health inequalities to persist into old age (Fors, Lennartsson, & Lundberg, 2007; Thorslund & Lundberg, 1994). There are different possible causes to health inequalities; often material factors, lifestyle, and psychosocial factors are noted in the literature. One of the most essential psychosocial factors in adult life is quality of work and employment (Marmot, Siegrist, & Theorell, 2011); hence work is an area central to reducing social inequalities in health (Albin et al., 2017).

People who occupy a lower socioeconomic position in society (i.e., have a lower level of education, have a lower income, and belong to a lower social class) have not only a higher

¹Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948.

prevalence of adverse physical working conditions, such as exposure to noise and adverse physical, ergonomic, and chemical exposures. They also have a higher prevalence of adverse psychosocial working conditions, such as low skill discretion, repetitive work, low influence at work, and job insecurity (Albin et al., 2017). Moreover, lower socioeconomic position has been associated with greater allostatic load (Johnson, Cavallaro, & Leon, 2017). High psychological job demands and long working hours are, however, more common in people with higher levels of education or in higher social classes (Toivanen & Vinberg, 2012). Having a combination of high work stress and lower occupational status have been suggested to increase the risk of poor mental and physical health problems over and above the sum of the risk of the two factors (Toivanen, 2011). In Sweden, job strain exposures also differ by country of birth. People born outside Europe who are working in Sweden have higher job strain and are exposed to heavier physical working conditions and more air pollution than those born in Sweden (Albin et al., 2017). However, psychosocial working conditions and their impact on ill health vary not only by socioeconomic position and ethnicity, but also by sex.

3.2 DIFFERENCES BETWEEN WOMEN AND MEN IN THE WORKFORCE

The workforce in Sweden is both horizontally and vertically sex segregated. Horizontal segregation occurs when women or men are over- or underrepresented in different sectors, industries, occupations, organizations, or workplaces (SOU, 2004). For example, the professions most dominated by women in Sweden are assistant nurse (*undersköterska*) and medical assistants (*sjukvårdsbiträden*). The professions most dominated by men are carpenters (*byggnadsträarbetare*) and joiners (*inredningssnickare*) (SCB, 2014). Vertical segregation occurs when women or men (most often women) are underrepresented in higher positions (Ellingsæter, 2013). This pattern is not unique to today's society. On the contrary, the differences between women and men in the workforce have been decreasing in recent decades in Sweden (Sverke et al., 2016). Both horizontal and vertical sex segregation can affect psychosocial working conditions, such as work tasks, the flexibility of working hours, the opportunity to influence one's work situation, the opportunity to work full-time or part-time, employment security, job demands, and financial resources, all of which may influence health. In most studies in Sweden from the end of the 1970s to the present, women have reported lower job control than men (Albin et al., 2017). Psychological demands increased between the beginning of the 1990s and the middle of the 2000s, particularly among women working in the public sector (Theorell, 2006).

In what has been called the gender-and-health paradox, women report more health problems than men but have a longer life expectancy (Rieker & Bird, 2005). Today there is a clear sex difference in health in Sweden during people's working years. Women have a higher risk of developing depressive symptoms, and men have a higher risk of developing heart diseases and symptoms (Albin et al., 2017). A difference between women and men in the association between psychosocial working conditions and health has been found in earlier research. For example, a study from 2002 (Karlqvist et al., 2002) found associations between high job strain and musculoskeletal pain in women but not in men. A Danish study from 2008 (Wieclaw et al., 2008) found that low job control was associated with an increased risk of

anxiety disorder in men but not in women; however, high emotional demands were associated with increased risk of depressive disorders in women but not in men. Nevertheless, most research indicate that if women and men are exposed to the same psychosocial working conditions, they seem to have the same risk of developing ill health, such as cardiovascular disease, depressive symptoms, chronic fatigue, and back pain (SBU, 2014a; 2014b; 2015; Theorell et al., 2014). A review study of research articles published between 1990 and 2013 (Theorell et al., 2015) found that job strain, low decision latitude, and bullying were associated with increased depressive symptoms in both women and men. Moreover, only around 18 to 30 percent of the variation in describing the level of demand and control experienced at work appears to be associated with genetic factors. However, there appears to be no differences between women and men in the amount of genetic influence on how they described their work environment, i.e., self-reported psychological working conditions (Theorell et al., 2016). This indicates that working conditions may have the same effect on health in women and men, but there is still a difference between women and men in self-reported psychosocial working conditions that could be due to the sex segregation in the workforce (Vingård, 2015; Sverke et al., 2016). It is, however, not clear if the health difference between women and men is only related to sex segregation in the workforce or if the health difference is also related to factors outside of work, e.g., work-life balance.

3.3 WORK-LIFE BALANCE

3.3.1 Work-family conflict

There has been a great deal of research on work-family conflict, and how such conflicts are associated with health. In the 1990s, the psychological load from the home interacted to a greater degree with work for women than men, with regard to causing illness (Hall, 1989, 1992). Earlier research in Sweden found that women's stress levels remained elevated after work, whereas men's stress returned to resting levels (Frankenhaeuser et al., 1989; Lundberg & Frankenhaeuser, 1999). In a Swedish study conducted 2001 (Krantz, Berntsson, & Lundberg, 2005), the interaction between work and household duties determined women's health, whereas it was long hours rather than household duties that had the greatest negative effect on men's health. However, a Swedish study conducted between 2008 and 2010 (Leineweber et al., 2012) concluded that both women and men experienced work-family conflict. Although women's self-rated health was more negatively affected by work-family conflict than men's; men experiencing work-family conflict had a higher risk of problem drinking than men who did not experience such conflicts, and both women and men experienced emotional exhaustion. Women with active jobs did not experience more work-family conflict than men in active jobs (Grönlund, 2007).

3.3.2 Lifestyle

Stress is not only associated with physiological and psychological factors, but also with behavioral factors. Stress has a negative influence on lifestyle habits such as physical activity, diet, smoking, alcohol, and risk-taking (Fransson et al., 2012; Hellerstedt & Jeffery, 1997; Nyberg et al., 2013). For example, people with high-strain or passive jobs were less likely than those with low strain or active jobs to have a healthy lifestyle (i.e., drink moderate

amounts of alcohol, not smoke, be of normal weight, and be physically active) (Heikkilä et al., 2013; Hellerstedt & Jeffery, 1997; Lallukka et al., 2004; Mohammad Ali & Lindström, 2006; Wemme & Rosvall, 2005). Stressful work conditions, such as high strain jobs, increase the probability of sedentary behavior and leisure-time passivity. The link between high-strain jobs and inactivity may be fatigue and the need for recovery, factors which studies suggest are associated with stressful work conditions (Heikkilä et al., 2013; Karasek & Theorell, 1990; Landsbergis et al., 1998; Morassaei & Smith, 2011). Unchallenging jobs, such as those that are passive, may reduce self-efficacy (i.e., one's belief in their own ability to achieve goals) (Bandura, 1986), and lower self-efficacy increases the probability of a more passive lifestyle (Karasek & Theorell, 1990; Landsbergis et al., 1998; Lallukka et al., 2004). The link between passive jobs and inactivity during leisure-time has been found to be more pronounced in men than in women. In women, non-work-related stressors influenced leisure-time inactivity more (Gimeno et al., 2009; Hellerstedt & Jeffery, 1997; Wemme & Rosvall, 2005).

Moreover, accumulated learning experiences derived from active jobs facilitate feelings of confidence and mastery (e.g., feelings of self-efficacy and having effective coping strategies), which in turn may encourage an active life outside of work (Karasek & Theorell, 1990). Another possible mechanism is integration: an overlap of place, time, people, and activities between work and leisure time. Researchers suggest that during their leisure time, people may explore specific knowledge and skills that they attain in connection with work or interests discovered at work (Staines, 1980; Tåhlin, 1987). Several studies have found associations between active jobs and active leisure (e.g., physically, politically, socially, and/or culturally active leisure) (Karasek 1976; Choi et al., 2010; Goitein & Seashore, 1980; Hellerstedt & Jeffery, 1997; Lallukka et al., 2004; Morassaei & Smith, 2011). Such associations were also the main reason to use the term “active” jobs (Karasek & Theorell, 1990).

3.3.3 Sense of coherence

Sense of coherence moderates the effect of work stress on health; i.e., those with a strong sense of coherence cope better with work stress than their counterparts with a weak sense of coherence (Albertsen, Nielsen, & Borg, 2001; Olsson et al., 2009). Having a strong sense of coherence has been associated with faster adaptation to negative life events than having a weak sense of coherence (Surtees, Wainwright, & Khaw, 2006). Employees who find their work meaningful, manageable, and comprehensible may be more resistant to the negative impact of work stressors (Kinman, 2008). Sense of coherence has also been associated with several health outcomes in women and men; however, the associations seem to be stronger in women (Larsson & Kallenberg, 1996). A strong sense of coherence is negatively associated with mental health (Eriksson & Lindström, 2006); positively associated with the personality traits of agreeableness, openness to experience, extraversion, and conscientiousness; and negatively associated with the personality trait of neuroticism (i.e., positively associated with emotional stability) (Feldt et al., 2007). In addition, a weak sense of coherence has been linked with an increased risk of mortality (Surtees et al., 2003). One study of people aged 41 through 81 years found that a strong sense of coherence was associated with healthy lifestyle factors, including eating fruit and vegetables, a lower

likelihood of smoking, and a greater likelihood of being physically active (Wainwright et al., 2007). Moreover, sense of coherence tends to increase with age (Eriksson & Lindström, 2005; Silverstein & Heap, 2015).

3.4 PSYCHOSOCIAL WORKING CONDITIONS AND LATE-LIFE HEALTH AND LEISURE

Several studies have observed associations between work stress and health over time. Although longitudinal studies are common, they have been limited by relatively short follow-up periods. Studies with longer follow-up periods are important because some consequences of work-related stress may not occur until much later in life. This is because environmental and personal influences accumulate over the life course. For instance, life trajectories of work stress can combine with lifestyle choices to cause an accumulation of health risks or advantages (Kuh et al., 2014). An example is the combination of work stress and physical inactivity and/or smoking, which are known predictors of mobility impairment in old age (Cooper et al., 2014). Stress may also produce long-term effects through biochemical pathways, such as elevated levels of insulin and cortisol. Cortisol can reach brain regions that are involved in memory and cognition (Lupien et al., 2007). Moreover, the physical frailty that can accompany aging may further exacerbate the disadvantages of physiological dysregulations caused by stress and by the linked chain of risk that has developed over the life course as the result of stress (Crimmins & Cambois, 2003; Kuh et al., 2014; Sindi et al., 2013). In studies that have more than 10 years of follow-up, work stress has been associated with outcomes such as ischemic heart disease, overweight, poor mental health, low back pain during working age, and all-cause mortality (Dalgard et al., 2009; Lallukka et al., 2008; Netterstrøm, Kristensen, & Sjøel, 2006; Shirom et al., 2011; Thorbjörnsson et al., 2000).

Because the older population is growing, studies investigating health beyond working life are becoming increasingly important. The association between work stress and cognitive outcomes in later life has received increasing attention in recent years (e.g., Andel et al., 2015; Sindi et al., 2016, 2017; Then et al., 2013). However, few studies have investigated how work stress is related to other relevant and common health and functional outcomes in retirement, such as physical functioning (Kulmala et al., 2013, 2014; Wahrendorf et al., 2012) and multimorbidity. Health problems in old age are often simultaneous and interrelated (Fillenbaum et al., 2000; Meinow et al., 2006), and multimorbidity (the coexistence of multiple chronic diseases) (Marengoni et al., 2011) and complex health problems (Meinow et al., 2006) are common in older people (76+ years). The concept “complex health problems” refers to the coexistence of health problems and functional limitations, i.e., to have severe problems in two or three of the health domains cognition/communication, mobility, and diseases/symptoms. Complex health problems generate the need for several providers of medical care and social services (Meinow et al., 2006). In general, mobility problems imply a need for social services and/or informal care; diseases and symptoms imply a need for medical care; and severe cognitive problems imply need for social services, medical, and/or informal care. In addition to generating complex care needs, complex health problems often have a broad impact on people’s lives. To the best of my knowledge, the studies in this thesis

are the first to investigate associations between work stressors in midlife and complex health problems in old age.

Kulmala *et al.* (2013; 2014) found that general stress symptoms in midlife were strongly associated with the degree of late-life disability, measured as self-reported impairment in activities of daily living (ADL) and instrumental ADL (IADL) and with self-reported late-life mobility problems (follow-up time 28 years) in both women and men. Wahrendorf *et al.* (2012) found associations between work stress and low self-reported physical functioning (follow-up time 10 to 20 years) after adjustment for sex. The studies in this thesis add to what is currently known in that they use both self-reports and objective tests to examine sex-specific associations between psychosocial working conditions (passive and high strain jobs) and physical functioning in old age.

Work-related resources may also accumulate over the life course and act as factors that protect health (Hakanen, Bakker, & Jokisaari, 2011). For example, active jobs in midlife have been associated with better cognitive function after retirement (e.g., Andel et al., 2011), and work complexity has been associated with better cognitive function and lower odds of psychological distress after retirement (e.g., Andel, Finkel, & Pedersen, 2015; Darin-Mattsson et al., 2015). However, to the best of my knowledge, no other study has investigated associations between active jobs and engagement with life (such as leisure activity) 20 or more years later. Late-life physical activity has been associated with better cognitive function, lower depression scores, and enhanced quality of life (Lindwall et al., 2007; Rennemark et al., 2009; Wang et al., 2012); mental (intellectually engaging) activities, with better cognitive functioning (Kåreholt et al., 2011; Wang et al., 2012); and social activity with happiness and better physical and cognitive function (Menec, 2003; Wang et al., 2012), later dementia onset (Fratiglioni, Paillard-Borg, & Winblad, 2004), and survival (Nilsen, Agahi, & Shaw, 2017).

4 AIM

4.1 GENERAL AIM

The overall aim of this doctoral thesis is to increase knowledge about long-term associations (20 years and beyond) between midlife psychosocial working conditions and late-life health and leisure activity in Sweden. The thesis also aims to investigate the role that sense of coherence in midlife plays in the association between psychosocial working conditions and all-cause mortality.

4.2 RESEARCH QUESTIONS

The specific research questions are:

- (1) Do high strain jobs in midlife predict complex health problems in old age? Is the association between high strain jobs in midlife and complex health problems in old age modified by level of education? (Study I)
- (2) Do high strain and passive jobs in midlife predict limitations in physical functioning in old age? (Study II)
- (3) Are associations between high strain, passive, and active jobs in midlife and all-cause mortality modified by sense of coherence? (Study III)
- (4) Do active jobs in midlife predict physical, social, and intellectual/cultural activity in old age? (Study IV)
- (5) Are there differences or similarities between women and men in any associations observed in the studies in the thesis? (Studies I-IV)

5 MATERIAL AND METHODS

5.1 DATA

5.1.1 The level of living survey and the SWEOLD study

Two linked Swedish surveys, the Level of Living Survey (LNU) and the Swedish Panel Study of Living Conditions of the Oldest Old (SWEOLD), were used in the thesis. The first LNU was conducted in 1968 (Erikson & Åberg, 1987), as part of the Governmental Commission on Low-Income earners (Låginkomstutredningen) that assessed the welfare of the Swedish population. The LNU 1968 was a random sample of 1 per 1000 of the Swedish population, about 6000 people aged 15 through 75, interviewed by professional interviewers in structured face-to-face interviews. To be precise, the first LNU wave in 1968 was a random sample of people from the latest Labour Force Survey (LFS), which in itself was based on a random sample of the Swedish population between the ages of 15 through 75 (non-respondents 0.6%). It was carried out by the Department of Sociology at Uppsala University in collaboration with Statistics Sweden. Since then, the Swedish Institute for Social Research at Stockholm University has been responsible for LNU. Follow-ups were carried out in 1974, 1981, 1991, 2000, and 2010, making it one of the longest running social science surveys in the world. In the 1968 through 1991 waves, response rates varied between 78.3 and 90.8 percent. Data from the 2000 and 2010 waves were not used in this thesis. Each wave of LNU covers a random national sample of people between the ages of 15 through 75 years (the lower age limit was changed to 18 in 1991). A random sample of immigrants and young people is added to each wave of LNU to keep the sample representative of the total population.

SWEOLD is an extension of LNU: when the participants have passed the upper age limit of 75, they are re-interviewed in SWEOLD. Face-to-face SWEOLD surveys were carried out in 1992 and 2002. They were followed by a telephone survey in 2004, a face-to-face survey in 2011, and most recently, a telephone survey in 2014. To be a part of SWEOLD 1992, respondents had to have been interviewed in any of the previous LNU surveys. However, to be a part of SWEOLD 2002, 2004, 2011, or 2014, respondents had to have been a part of a previous LNU *sample* regardless of whether or not they were interviewed. Response rates for SWEOLD have varied between 84.2 and 95.4 percent. SWEOLD 1992, 2002, and 2011 were based on face-to-face interviews with a structured questionnaire in the participants' homes or in institutions, at age 77 and older (76 and older in 2002). Proxy interviews and a mixed interview method were used to avoid high non-response due to frailty or cognitive impairment (Kelfve, Thorslund, & Lennartsson, 2013). If a respondent did not want to or could not participate in a face-to-face interview, a telephone interview, mixed interview, or a proxy interview was used instead. The proxy was often a spouse, close relative, friend, or health care professional (home care, institution). In SWEOLD 2004 and 2014, data were mainly collected through direct telephone interviews (Computer-Assisted Telephone Interviewing or CATI) with participants age 69 (70 in 2014) and above. If circumstances (e.g., hearing difficulties or health problems) meant that a participant could not take part in a

direct telephone interview, a proxy or mixed interview was conducted. In 2011 and 2014, a postal questionnaire was used as a last resort if other modes were not successful. For a more comprehensive description of LNU and SWEOLD, see (Fritzell & Lundberg, 2007) and (Lennartsson et al., 2014).

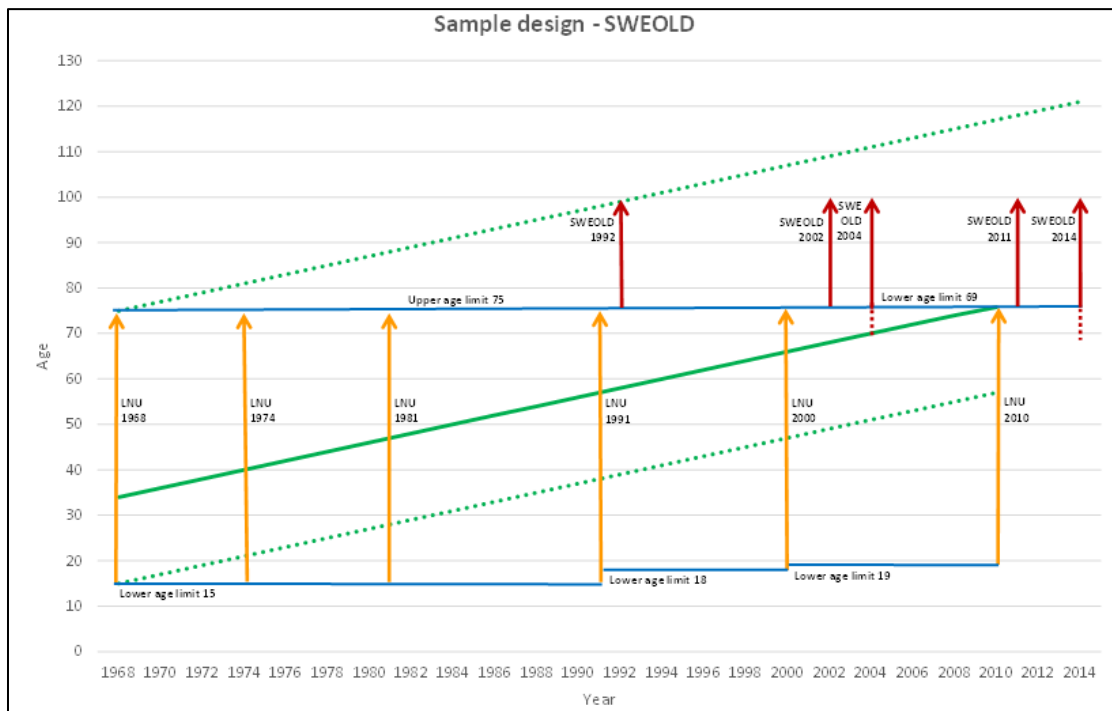


Figure 2. A schematic picture of the sample design of LNU and SWEOLD

Study I in this thesis used four linked sets of data: *i)* LNU 1968 linked with SWEOLD 2002, *ii)* LNU 1981 linked with SWEOLD 2002, *iii)* LNU 1981 linked with SWEOLD 2004, and *iv)* LNU 1991 linked with SWEOLD 2011. These linked sets were combined into one longitudinal dataset with a follow-up time of between 20 and 24 years. If a respondent from 1968 or 1981 did not respond to a question, the same person's answer from LNU 1974 was used. If a respondent from 1991 did not respond to a question, the same person's answer from LNU 1981 was used. This kind of back-up information did not exceed 10% in any of the questions. Associations between work-related stress and complex health problems were conducted in the four sets of data separately. Also, interactions between 1) linkage and level of education and 2) linkage and work-related stress were explored. No results differed significantly between the linked sets of data. In Study II, LNU 1991 and SWEOLD 2011 were linked. In Study IV, LNU 1991 and SWEOLD 2014 were linked. In Study III, data from LNU 1991 were linked with data from the Swedish Cause of Death Register.

In all the studies, people 65 years or over at baseline were excluded. People over 65 and still working are likely to have very specific characteristics that might have distorted the results, given that those still working over the age of 65 are probably healthier than those not working at this age. Also, people who did not have paid employment or were long-term unemployed, students, or housewives were also excluded because their working conditions could not be evaluated. However, separate analyses were conducted on this group to see how they differed from the population of interest.

5.2 OVERVIEW OF THE FOUR STUDIES IN THIS THESIS

	Study I	Study II	Study III	Study IV
Title	Associations between work-related stress in late midlife, educational attainment, and serious health problems in old age: a longitudinal study with over 20 years of follow-up	Work stressors in late midlife and physical functioning in old age	Work-related stress in midlife and all-cause mortality: can sense of coherence modify this association?	The influence of active jobs in midlife on leisure activity in old age
Data source	LNU: 1968, 1974, 1981, 1991 SWEOLD: 1992, 2002, 2004, 2011	LNU: 1991 SWEOLD: 2011	LNU: 1991 Swedish Cause of Death Register	LNU: 1991 SWEOLD: 2014
Design	Longitudinal design 20-24 year prospective cohort study	Longitudinal design 20 year prospective cohort study	Longitudinal design 16-23 year prospective cohort study	Longitudinal design 23 year prospective cohort study
Study sample	Born 1901–1945 Age 46–67 (median 57) at baseline. Age 69-91 (median 80) at follow-up n = 1,502	Born 1926–1934 Age 57–65 (median 60) at baseline. Age 77-85 (median 80) at follow-up n = 166-214	Born 1926–1949 Age 42–65 (median 50) at baseline n = 1,393	Born 1926–1944 Age 47–65 (median 53) at baseline Retrospective data at age 40, 45, and 50. Age 70-88 (median 76) at follow-up n = 768-772
Exposure	Self-reported: High job demands Low job control High job strain	Self-reported: High job demands Low job control High job strain Passive jobs	Self-reported and occupation-based: High job demands Low job control High job strain Passive jobs Active jobs	Occupation-based: Active jobs
Outcome	Complex health problems Mobility Diseases/symptoms Cognition/communication	Lung function Mobility Physical performance	All-cause mortality	Intellectual/cultural activity Social activity Physical activity
Measures of association	Binary logistic regression Multinomial logistic regression Generalized ordered logistic regression	Linear regression Ordered logistic regression Generalized ordered logistic regression	Hazard regression with Gompertz distributed baseline intensity	Ordered logistic regression Generalized ordered logistic regression

5.3 VARIABLES

5.3.1 Psychosocial working conditions

All measures of psychosocial working conditions in this thesis came from the job demand-control model (Karasek, 1979). Both self-reported and occupation-based measures of psychosocial working conditions were used. Self-reported measures were obtained from LNU 1968, 1974, 1981, and 1991. The occupation-based measures were obtained from a psychosocial job exposure matrix created by Johnson *et al.* (1990) on the basis of a random sample of 12,084 Swedish workers from the 1977 and 1979 Swedish Survey of Living Conditions (i.e., the ULF survey). The ULF survey, which was performed by Statistics Sweden, contained items specific to the job demand-control model (12 items on job control and 2 items on job demands). These items were used to generate average scores for job control and job demands for 262 occupations, separately for women and men. Average scores ranged from 0 to 10. Thus, the occupation-based measure of work stressors was based on the average work situation, for women and men separately, in a specific occupation. The matrix was coded in accordance with the three-digit Nordic Occupational Classification Codes, the same coding scheme used to code current occupation and occupational history in the LNU surveys.

Psychological job demands

In Study I, self-reported job demands were measured with two items: “Is your work hectic?” and “Is your work psychologically demanding (taxing)?” Participants who answered no to both questions were categorized as having low job demands. Those who answered yes to one of these questions were coded as having high job demands. In Studies II and III, the same two questions were used to measure job demands; however, the focus in these studies was the highest category of job demands (i.e., having both a hectic and psychologically demanding job). The occupation-based job demand scale was constructed on the basis of responses to two items: “Is your work hectic?” and “Is your work psychologically demanding (taxing)?” Response alternatives included 0 = “never” 1 = “sometimes,” and 2 = “often.” The job demand variable was transformed to vary between 0 and 10. Scores in the Study III sample ranged between 1.0 and 9.3 (mean = 4.9, SD = 1.4) and were dichotomized using a median split. Occupation-based job demand scores in the Study IV sample ranged between 1.3 and 8.2 (mean = 4.9, SD = 1.4).

Job control

The control dimension of the job demand-control model covers two sub-dimensions: personal schedule freedom (decision authority) and intellectual discretion (skill discretion). Decision authority was not measured in Study I since not all questions were available in LNU 1991. The responses to two questions were combined to measure self-reported intellectual discretion: “What is the level of education required by your job?” and “Is your job monotonous?” On the basis of the combined responses, jobs were categorized as: 1) repetitious/monotonous work, 2) *not* repetitious/monotonous work and minimum skill level, 3) *not* repetitious/monotonous work and 1 to 4 years of training (skill level required), 4) *not* repetitious/monotonous work and more than 4 years of training (skill level required).

Preliminary analyses using dummy variables for the job control categories confirmed that it was reasonable to analyze job control as a linear variable in Study I. In Studies II and III, self-reported job control was measured differently. A more up-to-date version of the job demand-control model, including both decision authority and intellectual discretion, was available in LNU 1991 (Sanne et al., 2005). Decision authority was assessed with two items: “To what extent do you have control over which tasks you must perform?” and “To what extent do you have influence over the way in which you must perform the tasks?” Response alternatives included 0 = “to a very high degree,” 1 = “to a high degree,” 2 = “to some degree,” 3 = “to a small degree,” and 4 = “not at all.” Intellectual discretion was assessed with four items. The first two were “To what extent does your job require that you learn new things?” and “To what extent does your job require you to be creative (resourceful, inventive)?” Response alternatives included 0 = “to a very high degree,” 1 = “to a high degree,” 2 = “to some degree,” 3 = “to a small degree,” and 4 = “not at all.” The third and fourth were “Does your job require skills?” and “Does your job require doing the same tasks over and over again (repetitious/monotonous)?” Response alternatives were “yes” (0) and “no” (1). The two latter questions were combined into one variable: low intellectual discretion (repetitious/monotonous jobs independent of skill level = 0), medium intellectual discretion (non-repetitious/monotonous jobs; no skills required = 2), and high intellectual discretion (non-repetitious/monotonous jobs; skills required = 4). This measure of intellectual discretion was added to the two questions regarding decision authority to create an index that ranged from 0 to 20. In Study II, this index variable was dichotomized using a median split. In Study III, it was used as a linear variable.

The occupation-based job control scale consisted of a linear composite of 12 items: influence over the planning of work, setting of work pace, how time is used in work, selection of supervisor, selection of co-workers, planning of work breaks, planning of vacations, flexible work hours, varied task content, varied work procedures, opportunity to learn new things, and experience of personal fulfillment on the job. Response alternatives included 0 = “never” 1 = “sometimes,” and 2 = “often.” The job control variable was transformed to vary between 0 and 10. The occupation-based job control scores in the Study III sample ranged between 1.5 and 8.8 (mean = 5.4, SD = 1.3) and were dichotomized using a median split. In Study IV, occupation-based job demand scores ranged between 1.8 and 8.2 (mean = 5.3, SD = 1.2).

High strain, active, passive, and low strain jobs

The variables “low strain” (low demands combined with high control), “high strain” (high demands combined with low control), “passive” (low demands combined with low control), and “active” (high demands combined with high control) were based on a cross-classification of job demands and job control. In Study I, self-reported job control was dichotomized by combining low control and medium-low control into low control and combining medium-high control and high control into high control. In Study II, self-reported job control was dichotomized using a median split. In Study III, self-reported and occupation-based job control was dichotomized using a median split. In Study IV, occupation-based active jobs were measured with a continuous variable that indicated level of activity, and passive, high strain, and low strain jobs were given the value 0 (the reference category). The variable ‘history of active jobs during midlife’ was created by matching occupation-based job control

and job demands with current occupation and with retrospective data (work history) on occupation at ages 40, 45, and 50, obtained from LNU 1991 (Jonsson & Mills, 2001), to calculate the mean of degree of active jobs during midlife (age 40 through 65). Work history was based on events and not on chronological time, i.e., main activity 'job' was registered in a temporal order, one by one, starting with the first job with duration of at least six months (Jonsson & Mills, 2001).

5.3.2 Sense of coherence

Sense of coherence (SOC) was measured as a possible modifier of the association between midlife psychosocial working conditions and all-cause mortality. It was measured with three questions: "Do you usually see a solution to problems and difficulties that other people find hopeless?" (manageability), "Do you usually feel that your daily life is a source of personal fulfillment?" (meaningfulness), and "Do you usually feel that the things that happen to you in your daily life are hard to understand?" (comprehensibility). Scoring was reversed for the question that measured comprehensibility. The three-item measure of sense of coherence was used in the analyses in the form of an index of between 0 and 6 points, and was given linear representation in the analyses of the interactions. To assess weak SOC (as compared with stronger levels of SOC), SOC was re-centered at 2 because only 11 participants had a SOC of 0 to 1. To assess strong SOC (as compared with weaker levels of SOC), SOC was centered at the highest value (SOC = 6). Re-centering involves creating new SOC variables with zero set at 2 (by subtracting 2 from the original SOC variable) or 6 (by subtracting 6 from the original SOC variable). When SOC is given linear representation in interactions, the assumption is that the association between psychosocial working conditions and mortality gradually changes with increasing SOC. SOC was centered at 2 when calculating the associations between psychosocial working conditions and mortality in people with a weak SOC and at 6 when calculating the same associations in people with a strong SOC.

5.3.3 Complex health problems

Severe health problems in old age were measured in three domains: 1) diseases and symptoms during the last 12 months, 2) cognition and/or communication, and 3) mobility. Those who had problems in two or three of these health domains were considered to have complex health problems (Meinow, 2008).

Diseases and symptoms

Diseases and symptoms were measured with a 14-item index that included self-reported fatigue/sleeplessness, dizziness, leg ulcers, diabetes, stomach ache, myocardial infarction/other heart problems, hypertension, stroke, breathlessness, chest pain, shoulder pain, joint pain, back pain, and underweight, experienced during the last 12 months. All but underweight were coded as "0 = no problems", "1 = mild problems", or "3 = severe problems". Underweight was measured as BMI, calculated using self-reported height and weight and categorized follows: ≥ 22 = not underweight, coded as 0; between 16 and 22 = mild underweight, coded as 1; < 16 = severe underweight, coded as 3 (Meinow, 2008; Parker et al., 2013). A summed index was created that ranged between 0 and 42. The cut-off for severe problems was defined by the quintile with worst health in SWEOLD 1992, which

corresponded to a score of 9 or more on the summed scale. Accordingly, the people in the highest quintile had at least three severe diseases or symptoms, two severe and three mild diseases or symptoms, or one severe and six mild diseases or symptoms, or nine or more mild diseases or symptoms.

Cognitive/communication problems

Cognition/communication was measured with tasks on registration (registering and repeating three objects), orientation (year/month/date, country), delayed recall (repeat the three objects from the first task), attention/concentration (subtract 7 from 100, then keep subtracting seven from what is left; repeat five times), and visual-spatial ability (the ability to draw a copy of a geometric figure). The last task was not part of the SWEOLD 2004 since SWEOLD 2004 was based on telephone interviews. Thus, in 1992, 2002, and 2011, the maximum score was 11; the cut-off was 7. In 2004, the maximum score was 10; the cut-off was 6. Respondents who scored below the cut-off in the test, who could not be interviewed directly (proxy), or who did not take the test was classified as having severe problems in this domain (i.e., severe cognitive and/or communication problems) (Meinow, 2008).

Mobility problems

Mobility was measured as the self-reported ability to stand without support, walk up and down stairs, walk 100 meters fairly briskly, and rise from a chair with arms crossed across the chest. The cut-off for severe problems was defined as the inability to do at least three of the four tasks. SWEOLD 2002 did not include the item “rise from a chair.” To include all four abilities when combining the SWEOLD surveys, data on “rise from chair” were imputed. Imputations were made on the basis of answers to questions related to this item, such as questions about being bedridden and being able to use the toilet without assistance. People interviewed by proxy were included (Meinow, 2008).

5.3.4 Physical functioning

Self-reported mobility and physical tests of lung function and physical performance were examined in Study II to obtain an overall view of physical functioning in old age. Mobility is foremost a measure of lower body function (Cooper et al., 2014), whereas physical performance primarily measures upper body function. Both reduced physical performance and reduced mobility are indicators of disability (Heiland et al., 2016; Minneci et al., 2015). Lung function is a good overall measure of health and frailty in old age (Roberts & Mapel, 2012). The three measures were chosen to create a nuanced overall picture but were not combined in an index as they may have different underlying constructs (e.g., related to the musculoskeletal, cardiovascular, respiratory, or nervous system) (Cooper et al., 2014).

Mobility problems

Mobility was measured with five capabilities. These included the self-reported ability to stand without support, walk up and down stairs, walk 100 m fairly briskly without difficulty, walk 500 m fairly briskly without difficulty, and run 100 m without difficulty. The answers (0 = “yes” and 1 = “no”) were combined in an index that ranged from 0 to 5.

Physical performance

Physical performance was measured as limitations in general physical functioning on the basis of nine tests that measured strength, range of motion, and hand function (Parker, Thorslund, & Lundberg, 1994; Parker et al., 1996): lifting one kilogram of goods, picking up a pen from the floor, placing both hands under the bottom or thighs, turning both hands palms up and then palms down, touching the right toes with the left hand, touching the left toes with the right hand, touching the right earlobe with the left hand, touching the left earlobe with the right hand, and getting up from a seated position in a chair without using the hands. The answers (0 = managed without difficulty, 1 = managed with difficulty, 2 = did not manage or did not want to attempt test) were combined in an index that ranged from 0 to 18. To avoid too few observations in each category, scores 3 to 4, scores 5 to 7, and scores 8 to 18 were combined.

Lung function

Lung function was measured with a peak expiratory flow (PEF) test in liters/minute, taken three times with the participant sitting down. The best score out of three was used in the analyses. Since PEF and height are strongly correlated, PEF was adjusted for height in old age; i.e., height was regressed on the PEF results, saving the residuals with the same scale as the original PEF test. The scale was reversed to let a higher value show worse lung function. Normal values for lung function in people 75 through 85 years are between 305 and 360 PEF in women (height 152 to 183 cm) and 420 and 515 PEF in men (height 160 to 190 cm) (Nunn & Gregg, 1989). However, as the lung function variable was reversed and the analyses were adjusted for height, the estimates cannot be directly compared with these normal values. No cut-off for the lung function variable was used because lung function was linearly associated with psychosocial working conditions.

5.3.5 All-cause mortality

Mortality data were obtained from the Swedish Cause of Death Register, which is kept by the National Board of Health and Welfare. It covers the entire population of Sweden. For participants aged 42 through 55 years at baseline, mortality data were available from the day of the interview in 1991 until 30 June 2007. For participants aged 56 through 65 years at baseline mortality data were available from the day of the interview in 1991 until 31 August 2014.

5.3.6 Leisure activity

Leisure or free time is usually defined as the amount of time remaining after all daily obligations (education, work, domestic tasks, and personal care) have been fulfilled. Leisure activity was measured in 1991 (LNU) and in 2014 (SWEOLD) as physical, social, and intellectual/cultural activity. The variables used differed slightly in 1991 and 2014. In a few cases, categories were combined to avoid too few observations in any category.

Physical activity

In 1991 and 2014, physical activity was measured with the question “Do you do any exercising, outdoor activities, or sports, such as going for long walks? If yes, how often?”

Answers were 0 = “no,” 1 = “yes, but less often,” 2 = “yes, 1-3 times/month,” 3 = “yes, approximately once a week,” and 4 = “yes, several times/week.”

Social activity

In 1991 and 2014, social activity was measured by asking “Which of the following leisure-time activities do you usually do?” and presenting a list of five activities. In 1991, the activities were visiting relatives, having relatives over to visit, visiting friends, having friends over to visit, and/or eating out at restaurants. Response alternatives were 0 = “no,” 1 = “yes, sometimes,” and 2 = “yes, often.” Scores were summed in an index that ranged from 0 to 10. Scores between 0 and 2 were combined to avoid too few observations in each category. In 2014, the five activities were visiting relatives, socializing with relatives outside the home, visiting friends, socializing with friends outside the home, and/or eating out at restaurants. Answers were 0 = “no,” 1 = “yes, sometimes,” 2 = “yes, often.” Scores were summed in an index that ranged from 0 to 10. Scores between 0 and 1 were combined to avoid too few observations in each category.

Intellectual/cultural activity

In 1991, intellectual/cultural activity was measured by asking “Which of the following leisure time activities do you usually do?” and presenting a list of four activities: going to the cinema, going to the theatre, reading books, and/or attending study circles/courses. Response alternatives were 0 = “no,” 1 = “yes, sometimes,” 2 = “yes, often.” Scores were summed in an index that ranged from 0 to 10. Scores between 6 and 8 were combined to avoid too few observations in each category. In SWEOLD 2014, intellectual/cultural activity was measured with two questions. The first was “Do you use the internet?” (0 = “no” and 1 = “yes”). The second, “Which of the following leisure time activities do you usually do?” was followed by a list of four cultural activities (going to the movies, theatre, museums, and exhibitions). Response alternatives were 0 = “no,” 1 = “yes, sometimes,” 2 = “yes, often.” The answers were combined in an index that ranged from 0 to 3.

5.3.7 Covariates

Age and *sex* were included in all four studies. Information was gathered from population registers and confirmed in interviews.

Physical working conditions were included in all four studies. Physical working conditions were measured at baseline in Study I with a six-item index that consisted of exposure to heavy vibrations (yes/no), daily sweating (yes/no), heavy lifting (yes/no), physically demanding work (yes/no), exposure to gas/smoke/dust (yes/no) and exposure to poison/acid/explosives (yes/no). In Study II and Study IV, physical working conditions were measured with a four-item index that consisted of exposure to heavy vibrations (yes/no), daily sweating (yes/no), heavy lifting (yes/no), and physically demanding work (yes/no). In Study III, they were measured with a four-item index that consisted of exposure to heavy vibrations (yes/no), daily sweating (yes/no), exposure to gas/smoke/dust (yes/no), and exposure to poison/acid/explosives (yes/no).

Level of education at baseline was included in all four studies as a covariate. It was divided into four groups: compulsory, vocational, upper secondary, and university. In the analyses in Study I that were stratified by level of education and in Study II, level of education was dichotomized into compulsory and beyond compulsory. Education is a key determinant of occupation and income (Galobardes et al., 2006).

Occupation-based social class at baseline was included in Studies III and IV, and in supplementary analyses in Studies I and II. Social class had four categories: unskilled blue-collar workers; skilled blue-collar workers, including small farmers and entrepreneurs without employees; lower white-collar workers, including large farmers and entrepreneurs with 1 to 19 employees; and intermediate and upper white-collar workers, including academic professionals and entrepreneurs with at least 20 employees.

Health at baseline was included in Studies I, II, and IV. The analyses in Studies I and IV were adjusted for an index of self-reported diseases and symptoms experienced during the last 12 months (pain in shoulders, back, hips, joints, and/or stomach; heart diseases and symptoms, including hypertension, chest pain, swollen legs, myocardial infarction, and heart failure; diabetes; leg ulcer; dizziness; breathlessness; fatigue; and sleep problems). Response alternatives were “0 = no problems”, “1 = mild problems”, or “3 = severe problems”. Myocardial infarction and heart failure were coded as 0 = “no problems,” 2 = “mild problems,” or 6 = “severe problems.” The analyses in Study II were adjusted for the ability to turn a faucet on or off (yes/no); joint pain during the past 12 months measured with a three-item index (pain in the back or hip; pain in the shoulders; and pain in the hands, elbows, or knees); and respiratory difficulties measured with a four-item index (asthma, dyspnea, tuberculosis, and coughing). Response alternatives were 0 = “no problems” 1 = “mild problems,” 3 = “severe problems.” Originally, Study III included a model that adjusted for self-reported heart diseases and symptoms (hypertension, chest pain, swollen legs, and myocardial infarction). Since this did not alter the results, this model was excluded to make the tables easier to read.

Mobility at baseline was included in Study I, Study II, and Study IV. Mobility was measured as the ability to walk 100 meters (yes/no), run 100 meters (yes/no), and walk up and down stairs (yes/no). If a person was unable to do two or three of these activities, he or she was coded as having mobility problems.

Social support at work was included in Study III. It was measured with the question “To what extent can you receive help and support from your colleagues when needed?” Response alternatives were 0 = “not at all,” 1 = “to a small degree,” 2 = “to some degree,” 3 = “to a high degree,” 4 = “to a very high degree.”

Leisure activity at baseline, i.e., intellectual/cultural, physical, and social activity, was included in Study IV. For a more comprehensive description, see Paper IV.

Mental health was measured with a three-item index in Study I (anxiety, depression/depressive symptoms, and general fatigue during the last 12 months) and with a two-item index in Study IV (anxiety and depression/depressive symptoms). Response

alternatives were 0 = “no problems,” 1 = “mild problems,” and 2 = “severe problems.” Supplementary analyses adjusted for mental health (the two-item index) were conducted in Study II and Study III. The findings of these supplementary analyses are presented in the results section of the introductory chapter (kappa) of this thesis.

Lifestyle factors at baseline were included in Study II; these factors were physical activity and smoking. Physical activity was assessed with the question “Do you engage in any exercise, outdoor, or sporting activity, such as long walks, and how often?” Response alternatives were 0 = “no,” 1 = “yes, but rarely,” 2 = “yes, one to three times per month,” 3 = “yes, approximately once a week,” and 4 = “yes, several times a week.” Smoking was assessed with the question “Do you smoke?” Response alternatives “yes”, “no, but I have quit”, and “no, never”, were dichotomized into never smoker and smoker or former smoker. Supplementary analyses on lifestyle were conducted in Studies I and III. The findings of these analyses are presented in the result section of the introductory chapter of this thesis (kappa). In Study I, physical activity was measured with the question “Which of the following leisure-time activities do you usually do?” Participants were then asked to choose one of three response alternatives for three activities: “dance,” “garden activities,” and “sports.” Response alternatives were 0 = “no,” 1 = “yes, sometimes,” 2 = “yes, often.” In Study III, physical activity was measured as in Study II.

The variable *hours worked* during the year before baseline was included in Studies I and II and in supplementary analyses in Study III. The findings of the Study III supplementary analyses are presented in the results section of the introductory chapter (kappa) of this thesis.

The variable *hours of household duties* at baseline was measured as hours worked per week in the household. Tasks included in household duties were cleaning, food purchases/cooking/dishes, and clothing/laundry/ironing. This variable was included in supplementary analyses in Studies I to III. The results of these analyses are presented in the results section of the introductory chapter (kappa) of this thesis.

Marital status at baseline was included in supplementary analyses in Studies I to III, and the findings are presented in the results section of the introductory chapter of this thesis. Possible answers were “not married,” “divorced/separated,” “widow/widower,” and “married/cohabiting.” The variable was dichotomized to distinguish between those who lived alone and those who lived with someone.

Having *children* living in the household (Study I) and having children born between 1981 and 1990 and living in the household (Studies II and III) at baseline was included in supplementary analyses (dichotomized into yes/no). The findings of these analyses are presented in the results section of the introductory chapter (kappa) of this thesis.

5.4 STATISTICAL ANALYSES

STATA versions 12 and 13 were used in all four studies to analyze the data.

In Study I, preliminary analyses were conducted with generalized ordered logistic regressions to test the assumption of parallel lines (equal associations over different values of the

outcome), i.e., parallel assumption test. The results revealed that the assumption was violated for the variable ‘number of health domains with severe problems.’ For this reason, multinomial logistic regressions were performed. This means that the reference category was ‘no severe health problems,’ and the category ‘problems in one health domain was compared to the category ‘no severe health problems,’ and the category ‘problems in two or more health domains’ (complex health problems) was also compared to the category ‘no severe health problems’ (Rabe-Hesketh & Skrondal, 2012). Binary logistic regression analyses were performed to look at the separate health domains (mobility, diseases/symptoms, and cognition/communication).

In Study II, after conducting generalized ordered logistic regressions, ordered logistic regression was conducted with the outcome physical performance and mobility. Ordered logistic regression is appropriate for ordinal variables if the assumption about proportional odds holds. Coefficients from an ordered logistic regression correspond to a weighted coefficient from a number of binary logistic regressions and are presented as an overall coefficient. The estimates can be interpreted as the decrease or increase in the log odds for every unit increase in the explanatory variable while all other variables are held constant. To better understand the output, the log odds are often transformed into odds ratios (OR) by taking the exponential function of the coefficients. Thus the odds ratio can be interpreted as the multiplied decrease or increase in the odds of the outcome. There is no assumption of equal step sizes with respect to the outcome in ordered logistic regression (Rabe-Hesketh & Skrondal, 2012). Linear regressions were conducted on lung function. In a linear regression there is an assumption of equal step sizes with respect to the outcome. The results of linear regression can be interpreted as the mean change of each higher category of the independent variable.

In Study III, hazard regressions were conducted. Unlike logistic regressions, which assess proportions, hazard regressions assess rates. The hazard ratio (HR) compares the hazard rates of two groups. These time-to-event analyses investigate how the risk of an event per time unit changes over time. This study used calendar days as time unit; more specifically change in age (in days). By using age in days instead of number of days in the study, left censoring regarding age changes in mortality risk are controlled for. Those who were still alive at the end of the follow-up were right censored. Gompertz distributed baseline intensity was used. Cox regression is a commonly used type of hazard regression. However, Cox regression does not take the actual time between baseline and an event into account, just the order of events. For example, it does not matter if an event happens two days, three days, or 100 days after previous event. Cox regression is therefore called non-parametric (or sometimes semi-parametric). With a parametric specification of the baseline intensity, we assume that the risk of something (e.g., death) has a certain shape over time. With Gompertz distributed baseline intensity, we assume that the risk of death increases exponentially over time (i.e., with age). The latter is a reasonable assumption if the population of interest is not exposed to war or an epidemic at the time of interest. Given that the risk of death from midlife until old age increases with age, the Gompertz regression was chosen for the analyses in Study III. However, in studies with a large amount of data and good information about the time of an event the choice between Cox and Gompertz regressions is not as crucial. Supplementary

analyses showed small differences between the results obtained with the Cox and Gompertz regressions. Both Cox and Gompertz are multiplicative models (Blossfeld, Golsch, & Rohwer, 2012).

In Study IV, after conducting generalized ordered logistic regressions, ordered logistic regression was used to analyze physical, intellectual/cultural, and social activity in midlife and old age. The results are presented as average marginal effects (AMEs) derived from the logistic regression analyses. AMEs can be interpreted as the average difference in the probability of the outcome depending on the value of the independent variable (Mood, 2010).

6 ETHICAL APPROVAL

The studies in this thesis are covered by the following ethical approvals by the Uppsala University Hospital Ethical Committee (Dnr 247/91 and Dnr 4010-91), the Ethical Research Committee of Karolinska Institutet (Dnr 03-413), and the Regional Ethical Review Board in Stockholm (Dnr 04-314/5, EPN Dnr 2010/403-31/4, and EPN Dnr 2014/1003-31/5). Informed consent was obtained from all participants. A relative (normally a spouse or an adult child) signed the consent form for participants who were physically or cognitively too impaired to sign the form at the time of the interview.

7 METHODOLOGICAL CONSIDERATIONS

In this section, methodological limitations and strengths of the four studies will be discussed.

7.1 INTERNAL VALIDITY

Validity refers to the extent to which a study measures what it intends to measure. To understand whether results are valid, we need to consider systematic errors (sources of bias) that may cause a lack of validity.

7.1.1 Selection bias

Prospective studies can be impacted by problems related to sample selection. When people that are randomly selected to participate decline (non-responders), or people that respond have missing data on the chosen variables of interest (item-non-responders), it biases the sample. A strength of this thesis was that baseline data in all four studies came from a random sample of the Swedish population with high response rates (78%-91%). The sample is therefore exceptionally representative, although we can never fully disregard selection bias due to non-response, given that those who participate in studies are generally healthier than the population as a whole.

Because of the high response rates at follow-up in the SWEOLD surveys (84%-95%), the effect of selective attrition (loss of participants) is likely small. However, selective survival affects all studies that include older people; i.e., those who survived to follow-up are most probably healthier than those who died before follow-up (and were therefore not part of the study sample) (Kelfve, 2015). The results of Study III can provide an indication of which psychosocial working conditions were associated with higher mortality risk (average survival time 13 years). The associations between these psychosocial working conditions and late-life health would most probably be an underestimation of the true association.

Moreover, Kelfve (2017) show that excluding the most disabled and disadvantaged may underestimate the associations. Therefore, to avoid a high item-non-response at follow-up and minimize the exclusion of the oldest old because of frailty or cognitive impairment, proxy and mixed interviews were conducted (Kelfve et al., 2013). However, it was not possible to include proxy or mixed interviews in the tests of cognitive and physical functioning in studies I and II. Instead, respondents who did not take the cognitive test or who could not be interviewed directly were coded as having severe cognitive and/or communication problems. Respondents for whom data on the tests of physical performance were missing and/or who were not able to stand ("Can you stand without support?" was a question used in the surveys) were assigned the lowest category of physical performance in supplementary analyses presented in the result section of this introductory chapter (*kappa*).

7.1.2 Information bias

The LNU and SWEOLD surveys provide nationally representative data on the study population of interest, and the variety of information in the surveys makes it possible to

assess many different aspects of people's lives. However, when conducting research based on survey data with large population samples, it is often not feasible to assess in-depth information on specific topics, and the variables may therefore lack precision. Short versions of original instruments of the job demand-control model, sense of coherence, and the Mini-Mental State Examination, were used in this thesis.

Psychosocial working conditions

The assessment of psychosocial working conditions used in this thesis was limited. Therefore, the validity of the measures was somewhat compromised, and there may be a risk of information bias. The measurement of job demand and control was not in accordance with the Swedish Demand-Control-Support Questionnaire (DCSQ), which is a modified and shorter version of Karasek's Job Content Questionnaire (JCQ) (Sanne et al., 2005). However, the questionnaire from Karasek's original job demand-control model, which was actually constructed with data from the LNU 1968 and 1974, was used. It also correlates highly with other known work stressors; e.g., job insecurity and lack of rest breaks (Karasek 1979). However, in LNU 1991, the control dimension was expanded to represent the Swedish DCSQ. I therefore used data from LNU 1991 as the baseline data in Study II and Study III. Still, demand and control were equally weighted in the model. I am aware of that the measures constructed at that time were perhaps not as well developed as they are today. However, I chose to use them because they provided the opportunity to investigate long-term associations between psychosocial working conditions and late life health and leisure over a unique follow-up time of 20 years and more.

Although the demand-control model was not intended to explain all stress related to work (Theorell, 2000), as a result, the model does not account for all the variance in work stress. If these unaccounted-for differences are also related to health in old age, analyses would probably underestimate the true association between stress and health. For example, some stress may be missed if, instead of measuring people's perception of possibly stressful work situations, one asks about the existence of work stressors. However, many factors have been identified as "stressors" that cause stress reactions among the majority of employees. Theorell (2000) posits that even though individual reactions to work might differ, it is still useful to look at stressors because in most cases, individual differences are random and somewhat equally distributed between different workplaces; i.e., the sum of reactions at different workplaces will probably still be the same. If research can identify the most significant stressors in the work environment that are associated with ill health, it is possible to prevent a lot of illness.

Moreover, I only measured a snapshot of work stress in the published papers included in this thesis. However, the participants were most likely established in their work careers, and people in this cohort had relatively low work mobility. To investigate duration of exposure, I matched occupational history from LNU 1991 with the psychosocial job exposure matrix to create measures of active, passive, and high strain jobs. I used a median split in occupation-based psychological job demands and job control and divided the sample into three age groups at baseline (42-45, 46-50, and 51-65) to better match the participants' ages at baseline with their occupational history. The starting points in the three graphs below include all

people that, for example, had high job strain at baseline (100%). They were then followed back in time to investigate history of psychosocial working conditions (e.g., high job strain at age 40 and at age 35). In general, the baseline occupation-based psychosocial working conditions of participants in Study III were similar to those they experienced several years prior to baseline (Figure 3).

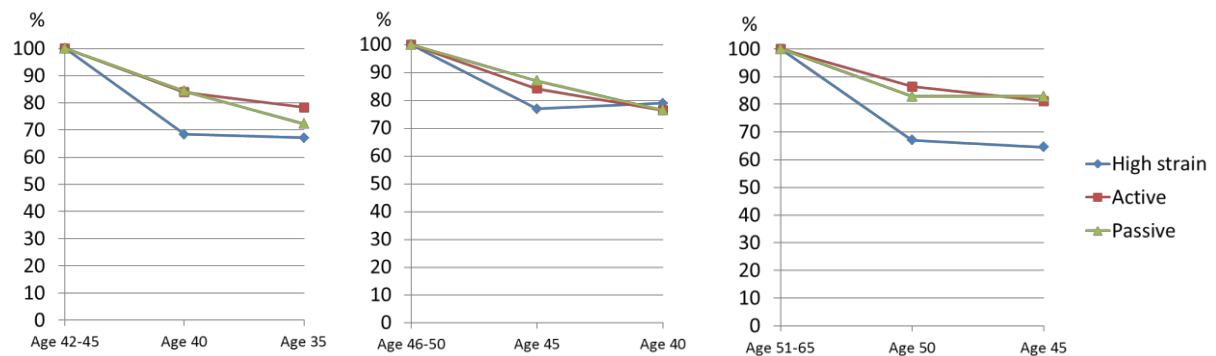


Figure 3 Psychosocial working conditions in the past

Sense of coherence

In this thesis, sense of coherence was assessed with a three-item Swedish version of Antonovsky's Orientation to Life Questionnaire sense of coherence questionnaire developed by Lundberg and Nyström Peck (1995) to be used in large population-based surveys. The Orientation to Life Questionnaire (OLQ) is used to measure sense of coherence and exists in a long version (29 items) and in a short version (13 items).

Lundberg and Nyström Peck (1995) conducted factor analyses to determine whether the three questions in the Swedish version really are measuring sense of coherence (to assess the internal validity of the questions). Although sense of coherence includes three distinct dimensions, these three dimensions are supposed to capture one underlying factor. Factor loadings for all three items were medium to high. Moreover, the three items were associated with health, sex, and age in a way similar to the items of the original instrument (Lundberg & Nyström Peck, 1995). Also, Lundberg (1997) found correlations of at least moderate strength between the 3- and the 29-item versions 0.66 ($n = 658$) and the 3- and 13-item versions 0.61 ($n = 675$).

Cognition

Cognition/communication was measured with a short form of the Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975). This short version has been validated by comparing it to a clinical diagnosis of dementia and to the full MMSE (Ericsson et al., 2017).

7.1.3 Confounding bias

In contrast to information and selection bias, confounding bias can be adjusted for after data collection. The two most-used approaches to adjust for possible confounders are stratification and multivariate models (Pourhoseingholi, Baghestani, & Vahedi, 2012). The downside of stratifying is that stratifying reduces sample size.

The analyses were adjusted for a variety of health and lifestyle factors at baseline in multivariate models. However, such variables are also likely to be in the causal chain. Thus, there is a risk that overadjustment may have attenuated the association between work stress and the outcomes (mortality and late-life health and physical functioning). There is also a risk that residual confounding may influence the observed associations, that is, confounding that is still present after adjustment (Rothman, 2008).

Socioeconomic conditions are associated with psychosocial working conditions and health, and are therefore a possible confounder. However, it is likely that there is a selection into jobs; i.e., that socioeconomic conditions act as a social determinant of health that enacts in the work environment via different mechanisms. So when adjusting for socioeconomic conditions, psychosocial working conditions may appear less important to health than they actually are (Albin et al., 2017). If these variables tap into the same variance in the outcome as the main independent variables, adjusting for them would result in overadjustment.

Similarly, people's health may affect the kind of work they have; for example, people who are already in poor health may end up in occupations with a lot of work stress. Selection of occupations and perceived work stress may be affected by the individual's physical and mental state. Controlling for numerous health problems and physical functioning at baseline rectified this issue at least to some extent, but I did not have the possibility to adjust for health prior to baseline in a satisfactory way. One further adjustment would have been to include health measurement from approximately 10 years earlier (e.g., LNU 1981), however this would have decreased the sample size markedly.

7.2 GENERALIZABILITY

The baseline data in all four studies came from random samples of people living in Sweden. Given the high response rates at baseline and follow-up, the results are likely to be generalizable to others in the same age cohorts living in Sweden. In 1991, the year the baseline data in Study II, Study III, and Study IV were gathered, psychological job demands were lower in northern Europe than in middle and southern parts of Europe (Smulders, Kompier, & Paoli, 1996). Thus, if generalized to countries other than Sweden, the results of the studies in the current thesis might underestimate the impact of psychosocial working conditions.

The results of Study IV, which included information on leisure-time involvement in organizations, may be more relevant to a Swedish context. In Sweden, there is a long history of organizational engagement that can be traced back to the 1950s. Examples include joining trade unions during working years and taking part in study circles to learn to do handicrafts, speak new languages, or play an instrument (Agahi, 2008). However, since this is only one

part of the intellectual/cultural leisure-time variable, it is not likely to have had a big influence on the results.

Moreover, the job demand-control model has been criticized as providing a reductionist picture of the psychosocial work environment that may not represent today's work environment (Mark & Smith, 2008). The model was developed during a period when the workforce was dominated by men in industrial jobs (Theorell, 2000). Therefore, what constitutes demand and control needs to be updated to suit workplaces today. For example, a study that investigated model fit for the demand-control model using the framework of structural equation modeling through confirmatory factor analysis and multi-group confirmatory factor analysis models indicated that excluding the item repetitive work would provide a better model fit (Chungkham et al., 2013). Moreover, as the demand for workforce flexibility increases and the boundaries between work and home increasingly blur, new decision latitude problems may arise. Also, temporary employment, which is increasing above all in people with a low level of education (Marmot, Siegrist, & Theorell, 2011), brings with it a lack of control that needs to be acknowledged. Still, recent research indicates that the balance between job demands and job control/resources is still relevant to occupational health today (Åhlin et al., 2017).

8 OVERVIEW OF THE STUDY RESULTS

The first study investigated long-term associations between self-reported psychosocial working conditions in midlife and complex health problems in old age. The second study investigated long-term associations between psychosocial working conditions and physical functioning in old age. The third study investigated whether sense of coherence could modify the association between self-reported and occupation-based psychosocial working conditions in midlife and all-cause mortality. The fourth study investigated long-term associations between psychosocial working conditions in midlife and late-life leisure activity.

8.1 STUDY I

Associations between work-related stress in late midlife, educational attainment, and serious health problems in old age: a longitudinal study with over 20 years of follow-up

The aim of the first study was to investigate associations between work stressors in midlife and complex health problems in old age and to see whether these associations differed between women and men, or by educational attainment. The associations were investigated in two models. Model I was adjusted at baseline for age, sex (except in the analyses already stratified by sex), hours worked the previous year, physical work environment, mental health, mobility, index of diseases and symptoms, and follow-up year. Model II was adjusted for the same variables as Model I and level of education at baseline. Supplementary analyses were conducted. A 95 percent confidence interval (CI) is presented. P-values of <0.05 were considered significant.

When women and men were analyzed together, *high job strain*, compared to low job strain, were associated with complex health problems in old age (OR 2.62, CI 1.03-6.69). This association was statistically non-significant after further adjustment for baseline level of education (OR 2.17, CI 0.82-5.74). No statistically significant associations were found between high job strain and severe diseases/symptoms, high job strain and severe mobility problems, or high job strain and cognitive impairment. In the analyses stratified by level of education, men with high job strain and high levels of education had three times higher odds of complex health problems in old age than men with high levels of education but without high job strain (OR 3.07, CI 1.19-7.93). The results differed statistically significantly from men with low levels of education and high job strain ($p<0.01$). Men with low levels of education and high job strain had lower odds of complex health problems in old age than men with low levels of education but without high job strain (OR 0.42, CI 0.17-1.02).

There was a statistically significant difference between women and men in the association between *high job demands* and complex health problems ($p<0.05$). Women were negatively affected by high job demands and men positively affected. The sex difference between job demands and severe diseases/symptoms drove this association ($p<0.05$). The pattern of

women being negatively affected by job demands and men positively was also observed in the association between job demands and severe mobility problems; however, the finding was not statistically significant. The pattern was also present in the association between *high job demands* and complex health problems in the sub-group of participants with low levels of education ($p < 0.001$). It was not present in the sub-group of participants with high levels of education. High job demands, compared to low job demands, were associated with lower odds of severe cognitive impairment/communication problems in women and men (OR 0.69, CI 0.50-0.95); a stronger protective association was found in men (OR 0.56, CI 0.35-0.88) than in women (OR 0.77, CI 0.49-1.22) (Model I). High job demands, compared to low job demands, remained statistically significantly associated with lower odds of cognitive impairment/ communication problems in men only (OR 0.60, CI 0.38-0.95) after further adjustment for baseline level of education (Model II).

Lower job control, which was given linear representation in the analyses, was associated with higher odds of complex health problems (OR 1.30, CI 1.01-1.67). The association was stronger in men (OR 1.58, CI 1.08-2.30) than in women (OR 1.12, CI 0.81-1.54) (Model II). Associations between lower job control and impaired cognition and mobility drove these associations.

All statistically significant associations in Model II remained significant in supplementary analyses (not included in Paper I), after additional adjustment for baseline occupation-based social class, marital status, children living in the household, amount of household duties, and lifestyle factors (smoking and physical activity).

8.2 STUDY II

Work stressors in late midlife and physical functioning in old age

The aim of the second study was to investigate associations between work stressors in late midlife and physical functioning in old age and to see whether these associations differed between women and men. The associations were investigated in three models. Model I was adjusted for age, hours worked previous year, physical work environment, and physical functioning at baseline. Model II was adjusted for the same variables as Model I and for lifestyle factors (smoking and physical activity) at baseline. Model III was adjusted for the same factors as Models I and II and for level of education at baseline. Supplementary analyses were conducted. P-values of < 0.05 were considered significant.

High job strain, compared to non-high strain jobs (i.e., passive, active, and low strain jobs) was associated with mobility problems in women (OR 2.97, $p = 0.008$). In men, the association was in the same direction but was not statistically significant (OR 2.56, $p = 0.117$) (Model III). No statistically significant associations were found between high job strain and objective tests of physical performance and lung function in old age.

In men, *passive jobs*, compared to non-passive jobs were associated with mobility problems (OR 2.57, $p = 0.051$) (Model I), limitations in physical performance (OR 7.72, $p = 0.006$)

(Model II), and poor lung function (β -coefficient 97, $p = 0.021$) (Model III). There were 166 observations in the analyses of associations between passive jobs and physical performance, so supplementary analyses were conducted in an attempt to achieve higher power. For the supplementary analyses, people that were not able to stand and/or whose physical performance test results were missing were placed in the lowest category of performance, which increased the sample size to 214. In the analyses of the larger sample, the association between passive jobs and limitations in physical performance in men was statistically significant in Model III (OR: 5.37, $p = 0.006$). In women, passive jobs were not associated with physical functioning in old age. However, the interaction between sex and passive jobs ($p = <0.001$) indicated that men's lung function was negatively affected and women's lung function was positively affected by having a passive job. Additionally, in the analysis of the larger sample ($n = 214$), sex statistically significantly modified the relationship between passive jobs and physical performance in all models.

Because of the small sample size in Study II, I conducted supplementary analyses with data from Study I to further investigate the long-term negative consequences of having a passive job. The analyses in Study I used data from 1,502 participants. The main analyses in Study II used data from 166-214 participants. These supplementary analyses showed that men in passive jobs had significantly higher odds of all health problems than men in active, high strain or low strain jobs (Table 1, Model I). After further adjustment for baseline physical activity and smoking, the overall results were attenuated (Table 1, Model II). There was also a sex difference, in particular in the relationship between passive jobs and complex health problems and passive jobs and severe diseases/symptoms: passive jobs seemed to be protective for women but not for men (Table 1).

Table 1 Associations between passive jobs and severe and complex health problems in old age

Passive (ref. all others)	Complex health problems ^a	Mobility problems	Cognitive impairment	Diseases/ symptoms
Model I	OR (p-value)	OR (p-value)	OR (p-value)	OR (p-value)
Women	0.54 (.074)	0.63 (.185)	1.07 (.783)	0.58 (.017)
p^b	**	ns	ns	**
Men	2.53 (.013)	2.09 (.023)	1.83 (.021)	1.74 (.035)
Model II				
Women	0.53 (.067)	0.63 (.179)	0.95 (.847)	0.62 (.036)
p^b	*	ns	ns	**
Men	2.30 (.026)	1.82 (.074)	1.66 (.053)	1.58 (.086)

Based on data from Study I. Results are presented as odds ratios. All analyses were adjusted at baseline for follow-up year and baseline characteristics: age, physical work environment, hours worked during previous year, mental health, mobility, an index based on all diseases and symptoms that were used to create the outcome variable, and level of education. Model II was adjusted for the same variables as Model I and for baseline physical activity and smoking. Results in bold have a p value of <0.05 . * $p < 0.05$. ** $p < 0.01$. ^aReference category no severe health problems. ^bInteraction between passive jobs and sex in their association with health in old age.

High job demands, compared to low job demands, were associated with mobility problems in women in all models (Model III: OR 2.55, $p = 0.008$). The interaction between sex and job demands indicated that women's mobility was negatively affected by high job demands, and

the opposite was found in men. High job demands were not statistically significantly associated with physical performance or lung function in either women or men. However, the point estimates of the association between job demands and lung function followed the same patterns as the association between job demands and mobility (i.e., women were negatively affected by high job demands and men positively affected). The same sex-specific pattern was also found in the supplementary analyses ($n = 214$ participants) of the association between high job demands and physical performance. In men, *low job control* was associated with mobility problems (Model III: OR 2.61, $p = 0.048$), limitations in physical performance (Model II: OR 4.95, $p = 0.024$), and poor lung function (Model II: β -coefficient 68, $p = 0.035$). In the supplementary analyses of physical performance that included 214 participants instead of 166, low job control was statistically significantly associated with limitations in physical performance in men in the final model (OR 3.62, $p = 0.029$). Similar patterns were observed in women's mobility and physical performance, but estimates were lower and not statistically significant. A statistically significant difference between women and men was noted, whereby men's lung function was more negatively affected by low job control than women's.

All statistically significant associations in Model III remained significant in supplementary analyses (not included in Paper II), after additional adjustment for baseline occupation-based social class, marital status, children living in the household, amount of household duties, and mental health (anxiety, depression, and general fatigue).

Finally, those excluded from the analyses (i.e., people who did not have paid employment or were long-term unemployed, students, or housewives) had higher odds of mobility problems (OR 1.19, $p = 0.463$), limitations in physical performance (OR 1.27, $p = 0.318$), and poor lung function (β -coefficient 23, $p = 0.151$), than the people who were included in the study sample. However, the differences were not statistically significant.

8.3 STUDY III

Work-related stress in midlife and all-cause mortality: can sense of coherence modify this association?

The aim of the third study was to investigate whether sense of coherence modified associations between occupation-based and self-reported high strain, passive, and active jobs in midlife and all-cause mortality, and whether any associations differed in women and men. The associations were investigated in two models. Model I was adjusted for age, sex (except in the analyses already stratified by sex), and physical work environment. Model II was adjusted for the same variables as Model I and for level of education and occupation-based social class. Analyses of sense of coherence were additionally adjusted for social support at work. Supplementary analyses were conducted. P-values of <0.05 were considered significant. A total of 15.9 percent of the study sample died during follow-up; average survival time was 13 years.

Self-reported high strain jobs were not statistically significantly associated with higher mortality risk. *Self-reported passive jobs*, compared to non-passive jobs (i.e., self-reported high strain, low strain, and active jobs), were associated with lower mortality risk in women (HR 0.60, CI 0.37-0.97) (Model II). Results from the interaction between passive jobs and sense of coherence (given linear representation in the analyses) show that passive jobs were associated with higher mortality risk in men with a weak sense of coherence (HR 2.76, CI 1.16-6.59), but not in men with a strong sense of coherence (HR 0.86, CI 0.46-1.61) (Model II). *Self-reported active jobs*, compared to non-active jobs (i.e., self-reported passive, high strain, and low strain jobs), were associated with higher mortality risk in both women and men (HR 1.40, CI 1.01-1.95) (Model II).

Occupation-based high strain jobs, compared to non-high strain jobs (i.e., occupation-based low strain, passive, and active jobs), were associated with higher mortality risk (HR 1.41, CI 1.01-1.96) (Model II). A weak sense of coherence magnified the mortality risk in women (HR 4.48, CI 1.64-12.26) and men (HR 2.90, CI 1.12-7.49) (Model II). Sensitivity analyses were conducted; in these analyses of occupation-based high strain and mortality, the first two years of follow-up were omitted. The results were similar to those of the main analyses but slightly attenuated. No statistically significant association was detected between *occupation-based active jobs* and mortality or between *occupation-based passive jobs* and mortality.

In women, *Self-reported high job demands* were associated with higher mortality risk than self-reported low job demands (HR 1.55, CI 1.00-2.38) (Model II). In men, *Self-reported low control* was associated with higher mortality risk than self-reported high control (HR 1.04, CI 0.99-1.09) (Model II). *Occupation-based high job demands* were associated with higher mortality risk than occupation-based low job demands in both women and men (HR 1.41, CI 1.04-1.92); the addition of a weak sense of coherence magnified the association (HR 2.04, CI 1.07-3.92) (Model II). No statistically significant association between *occupation-based low control* and mortality was detected.

All statistically significant associations in Model II remained significant in supplementary analyses (not included in Paper III), after additional adjustment for baseline marital status, children living in the household, amount of household duties, mental health (anxiety, depression, and general fatigue), and lifestyle factors (smoking and physical activity).

Finally, those excluded from the analyses (i.e., people who did not have paid employment or were long-term unemployed, students or housewives) had higher mortality risk than the people who were included in the sample (HR 1.57, $p < 0.001$).

8.4 STUDY IV

The influence of active jobs in midlife on leisure activity in old age

The aim of the fourth study was to investigate whether active jobs in midlife were associated with physical, social, and intellectual/cultural leisure activity in old age. The hypotheses were that *i)* active jobs are associated with leisure activity during working years and that this

participation in leisure activity continues after retirement, *ii*) active jobs are replaced by leisure activity after retirement, and *iii*) people who have more active jobs during their working years would also report greater participation in leisure activity after retirement. All analyses were adjusted for age, sex, mental health, diseases/symptoms, mobility, and physical work environment in midlife. Model II was adjusted for the same variables as Model I and for level of education and occupation-based social class. P-values of <0.05 were considered significant. As no statistically significant interactions between sex and active jobs (with $p < 0.05$) in their association with leisure activity were found, women and men were analyzed together. The results are presented as average marginal effects (AME) derived from the logistic regression analyses and expressed as percentage points calculated by multiplying the AME by 100.

The first hypothesis was partially supported: Model I showed significant associations between active jobs and all three categories of leisure activities in midlife. After further adjusting for level of education and occupation-based social class, only the probability of reporting a higher level of physical activity in midlife remained significant. It was, on average, 2.3 percentage points higher ($p = 0.017$) for each unit increase in the active job variable (range 0-5.7). Therefore, those with the maximum score for the active job variable (5.7) ($5.7 \times 2.3 = 13.1$) were 13.1 percentage points more likely to report a higher level of physical activity than those with a non-active job. As a next step in testing hypothesis one, longitudinal analyses were conducted to analyze whether active jobs were associated with leisure activity in old age. There were significant associations between active jobs in midlife and all three categories of leisure activities in old age. In Model II, a one-unit increase in the active job variable in midlife increased the probability of reporting a higher level of physical activity in old age by 3.3 percentage points ($p = 0.010$), a higher level of social activity in old age by 0.3 percentage points ($p = 0.020$), and a higher level of intellectual/cultural activity in old age by 1.2 percentage points ($p = 0.022$).

The second hypothesis was supported: strong evidence was found that active jobs in midlife are replaced by active leisure after retirement. To test the second hypothesis (that is, whether active leisure replaced active jobs after retirement), the analyses were adjusted for leisure activity in midlife. A one-unit increase in the active job variable in midlife increased the probability of reporting a higher level of physical activity in old age by 2.6 percentage points ($p = 0.036$), one extra point of social activity in old age by 0.2 percentage points ($p = 0.035$), and one extra point of intellectual/cultural activity in old age by 1.2 percentage points ($p = 0.017$).

The third hypothesis was not supported: the association between the average score for the active job variable across all measurements of active jobs during midlife and leisure activity after retirement was overall not stronger than the association between active jobs at baseline (1991) and late-life leisure.

9 DISCUSSION

9.1 THE LONG ARM OF PSYCHOSOCIAL WORKING CONDITIONS

9.1.1 The strain hypothesis

High strain jobs are considered to have stressful working conditions (e.g., Karasek, 1979; Karasek & Theorell, 1990). Chronic stress may have long-term effects on health through direct effects on health, but also through indirect effects on health via health-damaging behaviors (Elstad, 1998). That is, some effects of stress may not appear until later in life (Kuh et al., 2014). In this thesis, strong associations were found between self-reported high strain and self-reported mobility problems in old age, which is in accordance with earlier research (Kulmala et al., 2013; 2014; Wahrendorf et al., 2012). People with high strain jobs are more likely to have an unhealthy lifestyle (e.g., Heikkilä et al., 2013); however, in the current thesis, the association between high job strain and mobility in older adults was only partly explained by lifestyle factors (smoking and physical activity). This may indicate accumulated damage on the physical body from chronic stress; i.e., a direct effect of work stress on later physical functioning. However, there may be other lifestyle factors not measured that could have influenced the association. No statistically significant associations were found between self-reported high strain and complex health problems (Study I), or tests of physical performance and lung function (Study II) in old age. One may argue that self-reported high strain; i.e., work stressors, do have long-term implications, but implications that are not strong enough to more severely damage the body's function. However, reduced mobility may nevertheless have important negative implications for the older individual.

As suggested by previous research (Kulmala et al., 2013), the association between self-reported midlife work stress and mobility limitations was present in both women and men, however stronger in women. This may be explained by higher prevalence of disability in women and higher mortality in men. It may also reflect the double burden of work and family that is more pervasive in women than in men, a difference that was even more marked when the people in the study population were in the workforce (Hall, 1989; Hall, 1992). This double burden may make women's health more vulnerable to stress at work. However, these results remained after adjusting for marital status, children living in the household, amount of household duties, and mental health. To the best of my knowledge, there is no standard way to take work-life balance into account, and other variables not available in the data may still have had an effect. For example, given that the median age at baseline varied between 50 and 60 in the four studies, it is perhaps more likely that the double burden of work and informal care of dependent relative, such as taking care of an older parent (Schön & Johansson, 2016) would have affected the results more than having young children living at home. Unfortunately, we did not have the data needed to test this hypothesis.

Somewhat surprising results were found when stratifying the analyses by level of education (compulsory and beyond compulsory) in Study I. Level of education reflects resources derived from the opportunities that an education can offer in life (e.g., cognitive, psychosocial, and material), which in turn may be useful when coping with stressful

situations. Still, a high level of education magnified the association between high strain jobs and complex health problems in men. Dichotomizing level of education in this way meant that the high level of education (beyond compulsory) was not that high. Moreover, the people in the cohorts included in the studies were to a large extent educated prior to the educational expansion in Sweden (Chudnovskaya & Kolk, 2017). Thus, levels of education that would now be considered low may be viewed as normal rather than low in the cohorts analyzed in this thesis. Still, to have a high level of education but a repetitive job with low skill requirements may result in an understimulation, and this, in turn, may result in more stress. One may speculate that men's identity is more likely than women's to be linked with their job, and therefore this association was only found in men and not women.

The difference between the results of occupation-based and self-reported measures of high strain in this thesis is a bit ambiguous. Occupation-based high strain was associated with a higher risk of mortality, but self-reported high strain was not. It could be that occupation-based high strain captures a higher level of actual stress than self-reported high strain. There is always a risk that self-reported measures reflect properties of the individual to a greater extent than properties of the workplace, even when questions are asked about the environment (stressors) and not the person (perceived stress). Self-reported estimates are often affected by current mood or other extraneous factors that make the work environment appear more or less stressful than it actually is. The risk of self-report biases in subjective measures was demonstrated in a study by Häusser *et al.* (2011). Their results illustrated that a work environment with high job strain generated high cortisol levels; however, no subjective psychological reaction (no difference in subjective well-being). This discrepancy between "objective" and "subjective" stress reactions shows the importance of more objective measures of job strain. Although the occupation-based measures used in the current thesis were derived from self-reported psychosocial working conditions, the study sample was larger, approximately 12,000, and aggregated to averages for each occupation. Therefore the influence of individual personality differences was minimized.

9.1.2 The active learning hypothesis

Active jobs

According to the active learning hypothesis, high psychological demands may help increase learning, provided that the high demands are matched by the person's decision latitude at work. In turn, those with increased learning may perceive challenges as opportunities for personal growth rather than viewing situations as stressful (Theorell & Karasek, 1996). Surprisingly, in Study III, self-reported active jobs were associated with a higher mortality risk. This may reflect an imbalance between perceived demands and control, which may spring from the perhaps crude dichotomization of demands and control (median split) in the active job variable used in that article. That is, the high control in active jobs may not have entirely buffered the negative influence of high demands, although the control level wasn't low enough for the job to be categorized as a high strain job.

Active jobs will also induce feelings of mastery over time that stimulate feelings of self-efficacy. Feelings of self-efficacy and working conditions that are perceived as less stressful encourage active leisure time (Karasek & Theorell, 1990). Occupation-based active jobs were

associated with physical activity in midlife (Study IV), as suggested by previous research (e.g., Choi et al., 2010). According to the continuity theory of aging, maintaining a sense of continuity between midlife and late life may help people adapt to the process of aging (Atchley, 1989). The continuity in physical activity from midlife into old age observed in Study IV is in line with the findings of earlier research (Agahi, Ahacic, & Parker, 2006). However, after adjusting for physical activity in midlife, active jobs were still associated with physical activity after retirement. Thus, some of the association between active jobs and physical activity after retirement may reflect better physical functioning in old age due to less stressful working conditions in midlife, a link indicated by Study I and Study II. The results of Study IV also suggest that occupation-based active jobs may contribute to active engagement in social and intellectual/cultural activity later in life. The continuity theory of aging suggests that continuity may also manifest through the persistence of general patterns and does not require structures to be identical from the past (Atchley, 1989). When they enter retirement, people who had active jobs likely attempt to continue characteristics of those jobs, such as engaging in intellectually stimulating activities. This may help explain the higher engagement in intellectual/cultural activities observed among people who retired from an active job. A less stressful job may also leave people with the energy and time for social interaction at work that is followed by higher engagement in social activity after retirement.

Passive jobs

The passive dimension of the job demand-control model represents unchallenging jobs that can induce unlearning and loss of skill, which in turn may cause psychological atrophy and reduce self-efficacy. One of the clearest and strongest findings of this thesis was the association between self-reported passive jobs and ill health and limitations in late-life physical functioning in men. According to the life course perspective (Kuh et al., 2014), linked experiences or exposures (chains of risk) enhance risk because one disadvantage may lead to more disadvantages (Dannefer, 2003). Low belief in one's own abilities, something to which a passive job may contribute, has been associated with a passive and unhealthy lifestyle (Karasek & Theorell, 1990; Lallukka et al., 2004; Landsbergis et al., 1998; Mutambudzi & Javed, 2016). In particular, studies show that passive jobs are associated with physical inactivity in men (Gimeno et al., 2009; Hellerstedt & Jeffery, 1997). Adjusting for physical activity in the analyses partly explained the associations between self-reported passive jobs and men's late-life health and physical function that were found in the thesis project. However, the association between passive jobs and complex health problems remained, as did the associations between passive jobs and lower physical performance and lung function. Another possible explanation is that passive jobs may be perceived as stressful as a result of understimulation (Frankenhaeuser et al., 1971; Frankenhaeuser & Ödman, 1983). That is, the association between passive jobs in men and late-life health and physical functioning may be a result of both indirect effects of health-damaging behaviors and direct effects of stress.

But why are self-reported passive jobs associated with a passive lifestyle in men but not women, and why should passive jobs induce stress responses similar to those linked with overstimulation in men but not women? One may speculate that men are more negatively affected by self-reported passive jobs than women because women and men who report low

demands and low control have different types of occupations. Men who reported passive jobs foremost worked as truck driver/tram driver, mechanics, and workshop/engineering work. Women who reported passive jobs foremost worked as secretary/typist and cleaner. We know that the labor force is sex-segregated. This means that women and men tend to have different types of occupations. Thus, the effect may have been restricted to specific jobs in the “passive jobs” category rather than attributable to passive jobs per se. However, after adjusting for type of occupation in supplementary analyses, passive jobs in men were still associated with complex health problems, although the association was attenuated. This indicates that type of occupation only partly explains these associations.

As discussed earlier, perhaps men’s identity is more likely than women’s to be linked with their job, and men may therefore perceive low demands and low control differently than do women. One could speculate that a man with a self-reported passive job may feel that he has not lived up to the idea of hegemonic masculinity, which in turn contributes to a reduced self-efficacy. Hegemonic masculinity describes power and social hierarchy within the category “men”, and creates an ideal of how to be a high-ranking man— a stereotype of masculinity (Connell & Messerschmidt, 2005; Vänje, 2013). According to Hirdman (1990), the gender contract includes rules on responsibilities and rights for women and men, which creates gender-specific behavior. It confirms what some would call the “natural” order in society and gives women and men different positions. For example, men are assigned the role of provider and protector of the family, and women, the role of childbearing and providing care for her children (Hirdman, 1990; 2001). This contract creates a social pattern that Hirdman calls a gender system. The gender system involves two underlying beliefs: the dichotomy of male-female and the hierarchy of the man as the norm (Hirdman, 2001). Research that problematizes the consequences of the gender system on men’s health and on how the system may contribute to differences in the health of women and men is scarce. However, “doing gender” is an ongoing process (Hammarström et al., 2013; West & Zimmerman, 1987). Thus, what constituted masculinity in the late 1960s, 1970s, 1980s, and early 1990s may be changing, and masculinity may differ by cohort. Therefore, passive jobs today may not have the same long-term implications for men’s health in the future as they had for earlier cohorts of men.

9.2 SENSE OF COHERENCE AS A MODIFIER OF STRESS

A strong sense of coherence buffered the negative impact of occupation-based high strain on mortality in women and men. It also buffered the impact of self-reported passive jobs on mortality in men. This is in line with earlier research that has found people with a strong sense of coherence to be more resistant to the negative influence of work stress (Kinman, 2008; Olsson, Hemström, & Fritzell, 2009; Wainwright et al., 2007). A weak sense of coherence was more negative for women in high strain jobs than for men in high strain jobs. It may be that the ability to cope with the double-burden of work and family responsibilities is reflected in women’s sense of coherence. Having a strong sense of coherence does not necessarily mean feeling that everything in life is perceived as manageable, meaningful, and comprehensible. But there are aspects of life to which we devote a lot of our energy and that are important to sense of coherence: our feelings, our closest interpersonal relationships, our

job, and existential matters (Antonovsky, 2005). A strong sense of coherence may indicate having the social support needed to face challenging situations and feeling that your job is meaningful. The negative consequences of having a passive job for men may be reinforced by factors related to a weak sense of coherence, such as lack of social support.

9.3 THE RESULTS IN PERSPECTIVE: PEOPLE WITHOUT PAID EMPLOYMENT

Work provides not only income, but also a sense of meaning and identity, all of which are important for health and engagement in society. People without a paid job at baseline were excluded from all four studies. This exclusion criterion was inevitable, as psychosocial working conditions were the focus of this doctoral thesis. Although the absence of people without a paid job was not considered non-response in our studies, I still need to consider this as systematic selection that may have influenced my results via the healthy worker effect (i.e., unhealthy workers were “selected” out of employment). Those who work (e.g., our study sample) may be healthier on average than those in the same age group who do not work (McMichael, Spirtas, & Kupper, 1974). To put the results in perspective, supplementary analyses were conducted on those excluded from the study sample because they were not gainfully employed. These analyses supported the healthy worker effect, that is, people without paid employment had a higher mortality risk, worse physical functioning in old age, and were less active in leisure activity in midlife and in old age than those in the study sample.

10 CONCLUSIONS AND IMPLICATIONS

Labor market and public health policies already aim to maintain people's capabilities in midlife, since reduced functioning and health in midlife are related to early retirement (Lund & Villadsen, 2005). The results of this thesis underscore the importance of also observing and mapping the long-term role that psychosocial working conditions play in post-retirement life. The results support the notion that midlife psychosocial working conditions are important for late-life health, physical and cognitive function, and active leisure after retirement—and thus for healthy and active aging. Still, it is important to challenge what constitutes healthy and active aging. The way society and ultimately we as individuals view aging affects us throughout our entire life and may result in important limitations. In other words, “doing age” is like “doing gender.” The results also suggest that a strong sense of coherence—seeing life in general as meaningful, comprehensible, and manageable, may be an important personal resource in stressful circumstances.

Interventions on an organizational or societal level are often more cost-effective than interventions on an individual level, as they by nature include more people. Establishing societal health policies on a national level that are implemented at the organizational level (in workplaces) are therefore essential. New regulations on organizational and social work conditions started to apply in Sweden in March 2016; e.g., how to prevent and handle unhealthy workload and offensive treatment, since these are factors employers can improve and that are therefore amenable to organizational interventions (Arbetsmiljöverket, 2015). The results of this thesis suggest that it is crucial to reduce stress at work *and* induce intellectual stimulation and personal growth to promote healthy and active aging. It is therefore important to reinforce employees' control over the development and use of their skills and over decision-making. Recognition of individual growth and development; autonomy and empowerment; and employee involvement have been emphasized, together with accessible, positive and fair leadership; skilled communication; safe physical work; collaboration/teamwork; and appropriate staffing, as important factors that contribute to a healthy workplace (Lindberg & Vingård, 2012). Moreover, manageable, meaningful, and comprehensible work may strengthen sense of coherence (Carlsson & Kira, 2006).

To conclude, as retirement age gradually increases, the influence of work on future health could become more important. Investing in healthy workplaces by implementing interventions to improve the health of workers would reduce societal costs during working age and lower the cost of health and social care by improving the health of the older population. Hence, investment in healthy workplaces is a double win for society.

10.1 FUTURE DIRECTIONS

The next step would be to create a new psychosocial job exposure matrix based on data from today's workforce. After what constitutes control and demand is updated to suit modern workplaces, the revised matrix would enable us to forecast future health by building on the results of models already identified in this thesis. An updated psychosocial job exposure matrix could also be enhanced by the addition of new components that characterize what constitutes a workplace today. Linking job exposures matrices with register data on occupation would enable future research to investigate how timing, trajectories, and accumulation of psychosocial working conditions over the course of working life relate to late-life health and physical and cognitive functioning. Such investigations would help us better understand how psychosocial working conditions earlier in life shape health (dis)advantages later in life.

Given the results of this thesis, it is important to consider the role of sex and gender in the relationship between the exposure and outcome, and more carefully investigate possible cohort effects in the relationship between self-reported psychosocial working conditions and health in later life. Moreover, to better understand how psychosocial working conditions contribute to healthy and active aging, more research is needed on the interplay between work and life in general over the whole course of working life. For example, factors that contribute to work-family conflict may change over time from a conflict between work and childcare to a conflict between work and caring for an older parent, as a result of people retiring later.

More research is also needed to explore ways to enhance sense of coherence. An intervention that has successfully strengthened sense of coherence is the Mindfulness-Based Stress Reduction program (i.e., mindfulness meditation) (Weissbecker et al., 2002). Other possibilities may include group interventions, such as yoga (e.g., My Spirit Yoga).

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Vairāgya

Always let go, non-attachment